ECOLOGY AND TAXONOMY OF MYSIDS

(MYSIDACEA : CRUSTACEA)

by

Gwen Elizabeth Fenton, B.Sc.(Hons)

graduating 1986

submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

UNIVERSITY OF TASMANIA

HOBART

August 1985

Except as stated herein this thesis contains no material which has been accepted for the award of any other degree or diploma in any university, and that, to the best of my knowledge and belief, this thesis contains no copy or paraphrase of material previously published or written by another person, except when due reference is made in the text of the thesis.

Gwen Fenton

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

ABSTRACT

The total number of species of mysids known from Australian waters is 94, spanning 38 genera. Distribution records and keys to their identification are provided. Of these species, three new genera and twelve new species from Tasmania and Bass Strait have been described herein. In addition, numerous new records have been reported. Forty-seven of the mysid species and eight genera are endemic to Australia. The Australian mysid fauna exhibits strong links with that of the Indo-West Pacific region.

A 12-month field study was conducted at One Tree Point, Bruny Island Southern Tasmania, to investigate the role of mysids in an inshore coastal community. Fourteen species were recorded from the study site; of these, three i.e. Tenagomysis sp.2 n.sp., Anisomysis mixta australis and Paramesopodopsis rufa n.g. n.sp., formed dense swarms. The major peaks of abundance for each species were temporally separate. T.sp.2, A.mixta australis and P.rufa were found to exhibit a number of ecological differences, i.e. habitat partitioning (in zones parallel to shore), diet and diel activity, which may explain their co-existence.

These three species bred continuously during spring, summer and autumn. Breeding continued at a lower level during winter for T.sp.2 and P.rufa, but A.mixta australis appeared to cease breeding over winter. The breeding pattern was quite similar to that reported for most temperate mysids throughout the world.

The annual production was calculated from the field data for each species. Production was found to be greater for T.sp.2 than P.rufa and A.mixta australis, but the annual turnover (P:B) was higher for A.mixta australis (7.7) than T.sp.2 (5.5) and P.rufa (5.3). The values obtained were high compared to those reported for mysid species in colder climates.

Trophic relationships within the mysid community were examined. Gut contents analysis of the three mysids revealed a basically omnivorous diet, but P.rufa fed to a greater degree on small crustaceans while the diet of T.sp.2 was composed mainly of large fragments of macroalgae. The stomach contents of A.mixta australis was composed of fine particulate detrital matter. Comparison of stable isotope ratios (^{13}C:^{12}C and H:D) of the mysids with those of potential food sources supported these conclusions. In addition, several fish that fed on mysids were identified by analysis of their gut contents and others were implicated by comparison of their stable isotope ratios.

The results suggest that apart from their importance in the diet of several fish species, these mysids play a significant role in the turnover of the macroalgal biomass, and may also be important in structuring the zooplankton and/or meiobenthic community.

The results presented here have provided a major contribution to the knowledge of both taxonomy and ecology of Australian mysids. However, the need for continued examination of the taxonomy, biology and ecology of Australian mysids is recognized, and consequently, avenues for further research are suggested.

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to the following people who assisted me during the course of this project:

My supervisor, Dr. David Ritz, for his continual interest and encouragement throughout this study.

Dr. David Green, Department of Mines, for helpful advice and enthusiasm during the development of the organic combustion system.

Ron Mawbey and Richard Holmes, for their enthusiastic assistance with the boat work and diving; and to Steven Reid, Paul Cramp and Dr. David Ritz for their assistance with diving during the 24-hour sampling sessions.

The Director of the Australian Museum for a Post-Graduate Research Grant for the taxonomic section of my project.

The Curators of Crustaceans at the Museum of Victoria, Australian, South Australian, Queensland, Tasmanian and Western Australian Museums for arranging the loan of their mysid collections.

I gratefully acknowledge Dr. Karl Wittmann, Professor M. Murano, Professor J. Mauchline and Dr. M. Bacescu for helpful advice with mysid taxonomy.

My thanks are also extended to the staff and post-graduate students in the Zoology Department; in particular to Dr. J. Hickman for assistance with taxonomy and to Dominic O'Brien for useful "mysid discussion".

Special thanks are extended to my family and to my husband Malcolm for his continued interest and advice, and who also spent many hours typing and drawing graphs for this thesis.

I am also grateful for financial support from a Commonwealth Post-Graduate Research Scholarship.

CHAPTER 1

GENERAL INTRODUCTION

Mysids, also known as opossum shrimps, are small shrimp-like peracaridan crustaceans. Whilst generally less than 20mm in length, members of the Sub-Order Lophogastrida are frequently larger; for example, the largest mysid reported to date is a female of the bathypelagic species Gnathophausia ingens, measuring 35cm in length (Clarke, 1961). Mysids have managed to exploit virtually all parts of the marine environment, from the intertidal and littoral habitats to the bathypelagic depths of the oceans, and include all depth zones in between (Mauchline, 1980). A few species have been recorded from extremely deep water, for instance Amblyops magna was recorded at 7210m (Belyaev, 1966); Mysimenzies hadalis recorded in the Peru Trench, at a depth of 6200m (Bacescu, 1971); and Amblyops aequispina from a depth of 5760m (Birstein and Tchindonova, 1958). In addition to the purely marine mysids, there are many species which live in brackish water, and several which occur in fresh water.

Within the range of aquatic environments exploited by mysids, many species inhabit the water column just above substrates of algae, coral or sand; some rest on the substrate, others bury into sediment and yet others are truly pelagic. There are also a few species which inhabit specialized environments including caves and wells, and a few species (particularly in the Tribe Heteromysini), are commensal with sea anemones, hermit crabs and corals (Mauchline, 1980). Consequently, to sample mysids effectively, a range of collecting techniques is necessary. Suitable methods are discussed by Mauchline (1980).

Mysids are probably best known from their presence in shallow coastal water, forming large shoals (as defined by Mauchline, 1980) immediately above the substrate. Despite their abundance, particularly in shallow water environments, mysids have largely been overlooked in sampling programs, due to the fact that they are difficult to sample accurately with either conventional benthic or pelagic samplers. Nevertheless, the concentration of mysids in shallow coastal habitats presents a large potential food source, particularly for coastal fish both adults and juveniles, which utilize the shallow zones as nursery grounds (Mauchline, 1980).

Increasing awareness of the role that mysids play in the marine and freshwater environments has, in recent years, led to numerous publications

on various aspects of their biology and ecology. In particular, Mauchline (1980) gives a detailed review of the current knowledge of mysid biology. Further, the publication edited by Morgan (1982) includes a number of papers dealing with various aspects of mysid ecology. Together, these two publications provide a very valuable introduction to mysids.

However, within Australia, little is known of mysid taxonomy and virtually nothing of their life history and trophic relationships. Only one previous study in Australia has been devoted to the study of mysids. This was conducted in sub-tropical Queensland in the Brisbane River by Hodge (1963b). This general lack of knowledge about mysids in Australia has been a stimulus for the present study.

The objectives of this thesis were twofold. Firstly, it was proposed to deal comprehensively with the taxonomy of Australian mysids, particularly Tasmanian mysids (since this area has been extremely poorly documented), and provide a long needed list of species, keys to their identification and listing of distribution records. To this end it was necessary to compile mysid records from the literature, examine and identify Museum collections and specimens collected as part of this project from Tasmanian waters. Therefore, the first section of the thesis is devoted to the taxonomy of Australian mysids, including descriptions of three new genera and twelve new species collected from Tasmania and Bass Strait.

The second aim of this study was to investigate the role of mysids (most of which are described as new in the first section) in the nearshore coastal environment in south-eastern Tasmania, since they are commonly observed in large numbers in relatively shallow water. To assess the role of the three most abundant mysid species in this environment, a 12 month field study was conducted in a small coastal bay to obtain basic data of their distribution patterns, population dynamics, reproduction, production and biomass, together with an examination of their trophic relationships. The co-existence of these three mysid species is also discussed in terms of resource partitioning.

PART A

TAXONOMY AND BIOGEOGRAPHY OF THE AUSTRALIAN MYSIDS

CHAPTER 2

TAXONOMY OF THE AUSTRALIAN MYSIDS

2.1 INTRODUCTION

2.1.1 BACKGROUND

It was in 1776 that the first description of a mysid Cancer flexuosus (now Praunus flexuosus) was published by O.F. Müller (Tattersall and Tattersall, 1951). Since this first description the mysids have been grouped with various members of the Crustacea. They were first grouped with the Stomatopoda and Leptostraca by Latreille in 1803 (Tattersall and Tattersall, 1951). In 1817, Latreille reclassified the Crustacea separating the mysids from the Stomatopods forming a new group, the Schizopodes, later known as the Schizopoda, the name which was used for almost a century with only a few interruptions. After the first euphausiid was described by Milne-Edwards in 1830, both the mysids and euphausiids were grouped together in the Schizopoda until 1904. Calman (1904; in Tattersall and Tattersall, 1951) reclassified the Crustacea based on Hansen's scheme (1893) in which the Euphausiids and Decapods were grouped together as the Eucarida, and the Mysidacea, Cumacea, Isopoda, Amphipoda, and Tanaidacea grouped as the Peracarida. The same basic scheme is still followed today (Table 2.1).

ORDER MYSIDACEA

Definition. Peracarida, retaining primitive "caridoid facies" more or less completely. Carapace, shield-like covering most of the thorax and fused dorsally with head and thoracic segments 1-4 (thoracic 1 is incorporated into the head); cervical sulcus present dorsal to mandibles. Antennule with 3-segmented peduncle bearing 2 multi-segmented flagella; male with hirsute lobe more or less developed at distal end of terminal segment of peduncle ventral to flagella. Antenna with 3-segmented peduncle fused, not articulated; exopod generally present as a flattened scale; endopod flagelliform, 3 (rarely 4) proximal segments enlarged and distinct from multi-segmented distal portion. Eyes movably pedunculate when present. Labrum usually symmetrical, rounded anteriorly, or with anteriorly directed spine. Maxillule with well-developed lobes from segments 1-3; endopod rarely

Table 2.1 Classification of the Crustacea (after Marshall and Williams, 1975).

CLASS CRUSTACEA

SUB-CLASS CEPHALOCARIDA
SUB-CLASS BRANCHIOPODA
SUB-CLASS OSTRACODA
SUB-CLASS MYSTACOCARIDA
SUB-CLASS COPEPODA
SUB-CLASS BRANCHIURA
SUB-CLASS CIRRIPEDIA
SUB-CLASS MALACOSTRACA
SERIES LEPTOSTRACA
ORDER PHYLLOCARIDA
ORDER NEBALIACEA
SERIES EUMALACOSTRACA
DIVISION SYNCARIDA
ORDER PALAECARIDACEA
ORDER ANASPIDACEA
ORDER BATHYNELLACEA
DIVISION HOPLOCARIDA
ORDER STOMATOPODA
DIVISION PERACARIDA
ORDER THERMOSBAENACEA
ORDER SPELAEOGRIPHACEA
ORDER MYSIDACEA
ORDER CUMACEA
ORDER TANAIDACEA
ORDER AMPHIPODA
ORDER ISOPODA
DIVISION EUCARIDA
ORDER EUPHAUSIACEA
ORDER DECAPODA

present as a 2-segmented palp attached to basis. Maxilla, generally with setiferous lobes from the 3 basal segments; endopod usually forming a 2-segmented palp; exopod simple, broad with outer margin setose. Exopods of thoracic appendages natatory composed of many segments (sometimes absent from thoracic pairs 1, 2 and occasionally 8). First and sometimes second thoracic legs modified for feeding; thoracic 1 with leaf-like epipod. Ramified branchiae may be attached to precoxal segments of some or all thoracic appendages. Pleopods variable, usually with 2-segmented sympod bearing flagelliform exopod and endopod; frequently rudimentary in female, sometimes in male; often sexually modified in male. Uropods, with lamellar exopod and endopod, together with telson form tail-fan; statocyst generally present on endopod. Female brood pouch formed by 7, 3 or 2 pairs of lamellae, attached to thoracic appendages. Young liberated as miniature adults (Tattersall and Tattersall, 1951).

The Order Mysidacea is sub-divided into two sub-orders; the Lophogastrida and Mysida (Table 2.2). The Lophogastrida are easily recognized by the presence of gills on at least some of their thoracic appendages. As a group they are large in comparison to species in the sub-order Mysida, generally between 17-350mm (members of the genus Paralophogastrida are, however, smaller: 6-20mm). The majority of mysid species belong to the sub-order Mysida. Both sub-orders are represented in Australian waters but only one species, Gnathophausia ingens, is known from the sub-order Lophogastrida. Very little sampling for mysids has been carried out in Australian waters, especially the deep sea, so that as more sampling is conducted it would be expected that more species in the sub-order Lophogastrida will be found.

In 1977 Mauchline and Murano published a world list of the Mysidacea; this list was updated by Mauchline (1980). At this time there were over 780 species known distributed amongst more than 120 genera. Mauchline (1980) produced the first key to genera of the entire Order Mysidacea as part of a comprehensive review of the literature on the biology of mysids. These two references together with the bibliographies of Gordan (1957), Beeton and Clarke (1973), and the taxonomic works on the mysids of Japan (Ii, 1964), Indian Ocean (Pillai, 1973) and the large number of publications by W.M. Tattersall and O.S. Tattersall are invaluable to mysid taxonomists working in the Australian region.

The identification of species is based primarily on variation in such morphological features, as the antennal scale, mouthparts, thoracic legs, pleopods, telson and uropods. Tattersall and Tattersall (1951) have

Table 2.2 Major divisions within the Order Mysidacea.

ORDER MYSIDACEA
- SUB-ORDER LOPHOGASTRIDA
  - FAMILY LOPHOGASTRIDAE
  - FAMILY EUCOPIIDAE
- SUB-ORDER MYSIDA
  - FAMILY PETALOPHTHALMIDAE
  - FAMILY MYSIDAE
    - SUB-FAMILY BOREOMYSINAE
    - SUB-FAMILY SIRIELLINAE
    - SUB-FAMILY RHOPALOPHTHALMINAE
    - SUB-FAMILY GASTROSACCINAE
    - SUB-FAMILY MYSINAE
      - TRIBE ERYTHROPINI
      - TRIBE LEPTOMYSINI
      - TRIBE MYSINI
      - TRIBE HETEROMYSINI
    - SUB-FAMILY MYSIDELLINAE
  - FAMILY LEPIDOMYSIDAE
  - FAMILY STYGIOMSIDAE

discussed in detail differences in morphology existing within the Mysidacea. For convenience their figures have been reproduced here as a means of defining the terms used in the following chapters (Fig. 2.1).

2.1.2 HISTORICAL RECORD OF MYSID TAXONOMY IN AUSTRALIA.

The first reports of mysids in Australian waters were from the collections of the Challenger Expedition. Three species were collected in Port Phillip Bay, all new to science. They were described by Sars (1885) under the names Pseudomma australe, Anchialus angustus (now Paranchialina angusta Hansen, 1910) and Mysidopsis incisa (now Australomysis incisa Tattersall, 1927). In addition Sars (1885) recorded the widely distributed oceanic species Siriella thompsonii caught in the Tasman Sea (between Sydney Australia and Wellington New Zealand). The next record was by Zimmer (1918) who described Anisomysis australis (reduced to the level of sub-species of A.mixta by Bacescu in 1973a) also from Port Phillip Bay. W.M. Tattersall (1927-1940), however, made a substantial impact on the knowledge of mysids in Australia. In 1927, he described species from a collection held by the South Australian Museum. From this collection he described species in the genera Siriella, Leptomysis and Heteromysis together with a new genus Australomysis unique to Australia (described from the type material of Mysidopsis incisa studied by Sars in 1885). In 1928, W.M. Tattersall added a further three species, two in the genus Siriella and proposed a new genus, Australerythrops, bringing the number of unique genera to three and total number of species to 15.

W.M. Tattersall (1936a) recorded a further 23 species this time from the Great Barrier Reef, including one new genus, Pseudomysidetes russelli and three new species, Metamblyops stephensoni (now Gibberythrops stephensoni Murano, 1981), Erythrops yongei and Anisomysis incisa. He also discussed the affinities of the Great Barrier Reef mysid fauna, suggesting "that this fauna is part of a more or less uniform, shallow-water fauna extending from the Indian Ocean to the Western Pacific", since 16 of the Great Barrier Reef species had previously been recorded from the Dutch East Indies during the "Siboga" Expedition and eight were already known from the coast of India.

Four years later W.M. Tattersall (1940) described three new species, Siriella longidactyla, Gastrosaccus dakini and Afromysis australiensis (now Doxomysis australiensis Nouvel, 1966) from the coastal waters of New South Wales. In addition this collection yielded two new records for Australia, Anchialina penicillata and Gastrosaccus indicus. There were, however, three other species recorded from this collection,

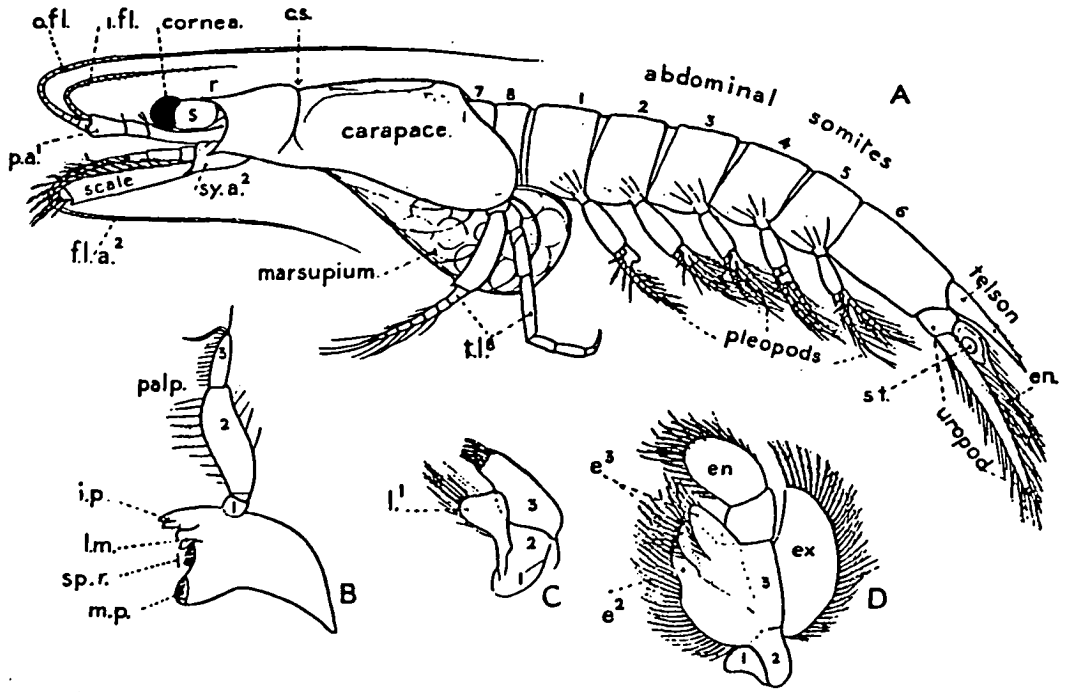


DIAGRAM I.—A, a typical Mysid, female, in side view; *p.a.*[1], peduncle of antennule composed of three segments; *o.fl.* and *i.fl.*, outer and inner flagella of antennule; *sy.a.*[2], sympod of antenna; scale, antennal scale: *fl.a.*[2], flagellum of antenna; *s*, stalk of eye; *r*, rostrum; *c.s.*, cervical sulcus; 7 and 8, 7th and 8th thoracic somites; 1–6, abdominal somites; *en*, endopod of uropod; *st*, statocyst; *t.l.*[8], 8th thoracic limb; B, mandible with three-segmented palp; *i.p.*, incisor process; *l.m.*, *lacinia mobilis*; *sp.r.*, spine row; *m.p.*, molar process; C, maxillule composed of three segments 1, 2, 3; l^1, lobe from first segment; D, maxilla with three segments in sympod 1, 2, 3; e^2, endite from second segment; e^3, bifid endite from 3rd segment; *en*, two-segmented endopod or palp; *ex*, exopodite.

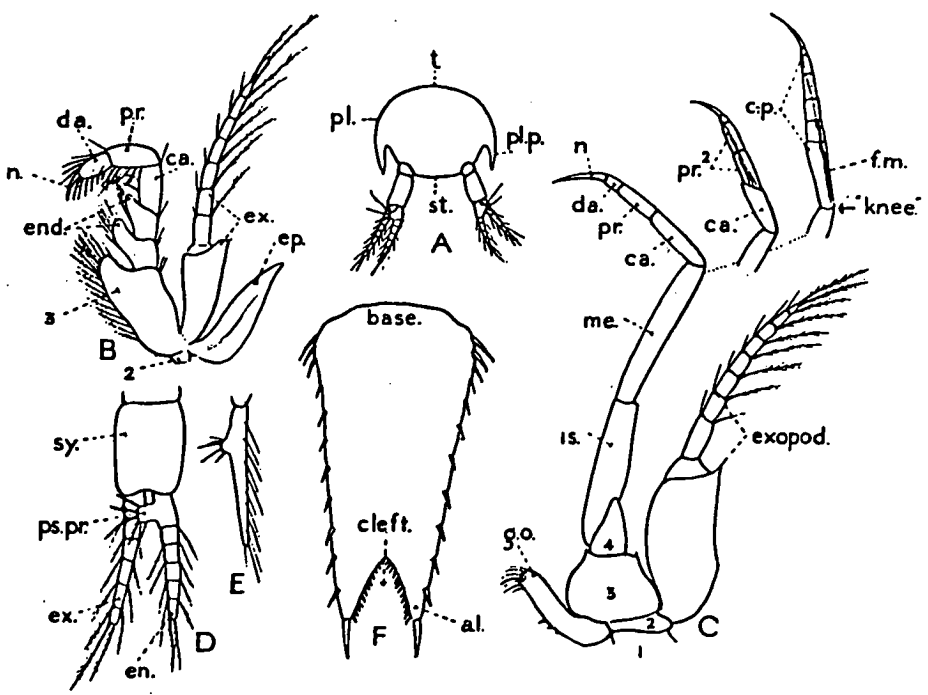


DIAGRAM II.—A, cross section of abdomen of a Mysid; *t*, tergum; *st*, sternum; *pl*, pleuron; *pl.p.*, pleural plate; B, 1st thoracic limb; 2, coxa; 3, basis with its endite; *end*, endites from ischium and merus respectively; *ca*, carpus; *pr*, propodus; *da*, dactylus; *n*, nail; *ex*, exopodite; *ep*, epipodite; C, 8th thoracic limb; 1, precoxa; 2, coxa; 3, basis; 4, præischium; *is*, ischium; *me*, merus; *ca*, carpus; *pr*, propodus; *da*, dactylus; *n*, nail; pr^2, propodus composed of two subsegments; *c-p*, fused carpo-propodus subdivided into five parts (Hansen terms the part distal to the "knee" joint the "tarsus."); *f.m.*, flexor muscle; *g.o.*, genital organ; D, a typical male pleopod; *sy*, sympod; *ex*, exopod; *en*, endopod; *ps.pr.*, pseudobranchial process; E, a typical reduced female pleopod; F, telson showing base and cleft; *a.l.*, apical lobe ending in a strong apical spine.

Fig. 2.1 Mysid morphology.

(After Tattersall and Tattersall, 1951; p.15 & 23).

according to Dakin and Colefax (1940), that were "in the process of being described by Professor W.M. Tattersall". As far as can be ascertained these three species were never fully described before his death in 1943 (and attempts to locate his type material have been unsuccessful). Two of these species were, however, interesting discoveries from Australian waters, firstly a species in the small Family Petalophthalmidae, genus Petalophthalmus, which is unusual in that it does not have statocysts. The second species, possibly belonged in the genus Tenagomysis which previously was only known from New Zealand waters. The third species, in the genus Gastrosaccus, was the dominant species of this genus caught in the coastal plankton samples; this species is described in section 2.3.2.2.4.iii. In 1941, Fage reported the first record of a member of the sub-order Lophogastrida, Gnathophausia ingens, from the New South Wales coast.

After W.M. Tattersall's death, the taxonomy of Australian mysids suffered years of neglect. Only a few records were published from the time of W.M. Tattersall's death till Bacescu and co-workers began studying Australian mysids in the late 1970's. O.S. Tattersall (1955) recorded Katerythrops oceanae and Gnathophausia ingens, from the west coast of Australia. Hodge (1963a) described a new species Rhopalophthalmus brisbanensis from the Brisbane River. Pillai (1973) reported Siriella aequiremis, Anchialina dentata, Pseudanchialina inermis, S.gracilis, Doxomysis quadrispinosa Anisomysis hispida and an unidentified species of the genus Euchaetomera from stations on the west coast of Australia sampled as part of a large scale investigation of the mysids of the Indian Ocean. Taniguchi (1974) working in the eastern Indian Ocean recorded Euchaetomeropsis merolepsis from the west coast of Australia.

It was not until 1979 that investigation of the taxonomy of Australian mysids resumed in earnest. Bacescu (1979) identified a collection of mysids from Heron Island, Queensland. This collection provided the first record of Anchialina zimmeri, Gastrosaccus pacificus, Siriella quadrispinosa and S.distinguenda from Australian waters and also added two new species, Heteromysis abrucei and H.heronensis. In 1980, Bacescu and Bruce added 3 more species, H.australica, H.stellata and H.harpaxoides, all from the reefs around Heron Island. The latter two species are commensal with the hermit crab species Aniculus sp. and Dardanus megistos respectively. Udrescu (1981) described a new species Siriella bacescui also from the Great Barrier Reef.

Then in 1982 Bacescu and Udrescu described five more new species, this time from Moreton Bay Queensland: Gastrosaccus daviei, G.brisbanensis, G.queenslandensis, Doxomysis proxima and Tenagomysis aseta. Furthermore,

they provided additional details on the description of Doxomysis australiensis (Tattersall, 1940) from a Queensland population and recorded G.bengalensis for the first time in Australian waters. Also in 1982 Greenwood and Hadley recorded Idiomysis inermis from Moreton Bay Queensland, a species previously known only from the coast of India (Tattersall, 1922). A third paper in 1982 by Panampunnayil, described Petalophthalmus australis from Western Australia, which is the same species partially described by Tattersall in Dakin and Colefax (1940), although Panampunnayil was unaware of this fact.

Bacescu (1983) described an additional three species from the coral reefs near Heron Island: Heteromysoides longiseta, Heteromysis tethysiana and Heteromysis macrophthalma. In 1984 Bacescu and Udrescu described a new genus Halemysis from South Australian material collected by Hale in 1941. Also in 1984, Panampunnayil described two new species, viz, Anisomysis gracilis and A.robustispina, from Western Australia.

In addition to the published records of mysids, a collection held by the Australian Museum from Lizard and Heron Islands on the Great Barrier Reef identified by Dr. Sue Talbot, includes the first records of Anisomysis lamellicauda, A.pelewensis, Prionomysis stenolepsis, Siriella affinis and S.media for Australia.

2.2 LIST OF THE AUSTRALIAN MYSID SPECIES

Mysid collections held in the Tasmanian, Victorian, and South Australian Museums were examined and identified. The Great Barrier Reef collection held in the Australian Museum and a small collection from the Queensland Museum were also examined and the identifications checked. These results, together with those obtained from mysid collections made during the present study from Tasmanian waters, have been combined with the records in the literature to provide a much needed comprehensive list of the Australian mysids. Three new genera and 12 new species have been described, bringing the total number of mysid species known from Australia to 94 distributed amongst 38 genera.

ORDER MYSIDACEA

SUB-ORDER LOPHOGASTRIDA

Family Lophogastridae

Genus Gnathophausia Willemoes-Suhm, 1873

G.ingens (Dohrn, 1870)

SUB-ORDER MYSIDA

Family PETALOPHTHALMIDAE

Genus Petalophthalmus Willemoes-Suhm, 1874

P.australis Panampunnayil, 1982

Family MYSIDAE

Sub-family BOREOMYSINAE

Genus Boreomysis G.O. Sars, 1869

B.sibogae Hansen, 1910

Sub-family SIRIELLINAE

Genus Hemisiriella Hansen, 1910

H.parva Hansen, 1910

H.pulchra Hansen, 1910

Genus Siriella Dana,1850

S.aequiremis Hansen, 1910

S.affinis Hansen, 1910

S.anomala Hansen, 1910

S.australis W.M. Tattersall, 1927

S.bacescui Udrescu, 1981

S.distinguenda Hansen, 1910

S.dubia Hansen, 1910

S.gracilis Dana, 1852

S.halei W.M. Tattersall, 1927

S.inornata Hansen, 1910

S.longidactyla W.M. Tattersall, 1940

S.media Hansen, 1910

S.nodosa Hansen, 1910

S.quadrispinosa Hansen, 1910

S.thompsonii (Milne-Edwards, 1837)

S.vincenti W.M. Tattersall, 1927

S.vulgaris Hansen, 1910

Sub-family RHOPALOPHTHALMINAE

Genus Rhopalophthalmus Illig, 1906

R.bribanensis Hodge, 1963a

R.dakini O.S. Tattersall, 1957

Sub-family GASTROSACCINAE

Genus Anchialina Norman and Scott, 1906

A.dentata Pillai, 1973

A.grossa Hansen, 1910

A.penicillata Zimmer, 1915

A.typica (Kroyer, 1861)

A.zimmeri W.M. Tattersall, 1951

Genus Gastrosaccus Norman, 1868

G.daivei Bacescu and Udrescu, 1982

Genus Haplostylus Bacescu, 1973b

H.(G.)bengalensis Hansen, 1910

H.(G.)brisbanensis Bacescu and Udrescu, 1982

H.(G.)dakini W.M. Tattersall, 1940

H.(G.)indicus Hansen, 1910

H.(G.)pacificus Hansen, 1912

H.(G.)queenslandensis Bacescu and Udrescu, 1982

H.sp.1 n.sp.

Genus Paranchialina Hansen, 1910

P.angusta (G.O. Sars, 1883)

Genus Pseudoanchialina Hansen, 1910

P.inermis (Illig, 1906)

P.pusilla (G.O. Sars, 1883)

Sub-family MYSINAE

Tribe Erythropini

Genus Australerythrops W.M. Tattersall, 1940

A.paradicei W.M. Tattersall, 1940

Genus Erythrops G.O. Sars, 1869

E.yongei W.M. Tattersall, 1936a

Genus Euchaetomera G.O. Sars, 1883

E.sp.

Genus Euchaetomeropsis W.M. Tattersall, 1909

E.merolepsis (Illig, 1908)

Genus Gibberythrops Illig, 1930

G.stephensoni (W.M. Tattersall, 1936a)

Genus Hypererythrops Holt and Tattersall, 1905

H.spinifera (Hansen, 1910)

Genus Katerythrops Holt and Tattersall, 1905

K.oceanae Holt and Tattersall, 1905

Genus Pseudomma G.O. Sars, 1870

P.australe (G.O. Sars, 1883)

Genus Synerythrops Hansen, 1910

S.intermedia Hansen, 1910

Tribe Leptomysini

Genus Allomysis n.g.

A.sp.1 n.g. n.sp.

Genus Australomysis W.M. Tattersall, 1927
A.acuta W.M. Tattersall, 1927
A.incisa (G.O. Sars, 1883)
A.sp.1 n.sp.
Genus Doxomysis Hansen, 1912
D.australiensis (W.M. Tattersall, 1940)
D.littoralis W.M. Tattersall, 1922
D.longiura Pillai, 1963
D.proxima Bacescu and Udrescu, 1982
D.quadrispinosa (Illig, 1906)
D.sp.1 n.sp.
Genus Iimysis Nouvel, 1966
I.sp.1 n.sp.
Genus Leptomysis G.O. Sars, 1869
L.australiensis W.M. Tattersall, 1927
Genus Mysidetes Holt and Tattersall, 1906
M.halope O'Brien, (in press)
Genus Prionomysis W.M. Tattersall, 1922
P.sp.1 n.sp.
P.stenolepis W.M. Tattersall, 1922
Genus Promysis Dana, 1850
P.orientalis Dana, 1852
Genus Pseudomysidetes W.M. Tattersall, 1936a
P.russelli W.M. Tattersall, 1936a
Genus Tenagomysis Thomson, 1900
T.sp.1 n.sp.
T.sp.2 n.sp.
T.sp.3 n.sp.

Tribe Mysini
Genus Anisomysis Hansen, 1910
A.bipartoculata Ii, 1964
A.gracilis Panampunnayil, 1984
A.hispida Pillai, 1964
A.incisa W.M. Tattersall, 1936a
A.lamellicauda (Hansen, 1912)
A.laticauda Hansen, 1910
A.mixta australis Nakazawa, 1910
A.pelewensis Ii, 1964
A.robustispina Panampunnayil, 1984
Genus Halemysis Bacescu and Udrescu, 1984
H.australiensis Bacescu and Udrescu, 1984

Genus Idiomysis W.M. Tattersall, 1922

I.inermis W.M. Tattersall, 1922

Genus Paramesopodopsis n.g.

P.rufa n.g. n.sp. Fenton, 1985a

Genus Tasmanomysis n.g.

T.oculata n.g. n.sp. Fenton, 1985b

Tribe Heteromysini

Genus Heteromysis S.I. Smith, 1873

H.abrucei Bacescu, 1979

H.australica Bacescu and Bruce, 1980

H.harpaxoides Bacescu and Bruce, 1980

H.heronensis Bacescu, 1979

H.macrophthalma Bacescu, 1983

H.stellata Bacescu and Bruce, 1980

H.tasmanica W.M. Tattersall, 1927

H.tethysiana Bacescu, 1983

H.waitei W.M. Tattersall, 1927

H.zeylanica W.M. Tattersall, 1922

Genus Heteromysoides Bacescu, 1968a

H.longiseta Bacescu, 1983

Sub-family MYSIDELLINAE

Genus Mysidella G.O. Sars, 1872

M.sp.1 n.sp.

2.3 SYSTEMATICS

Format. This taxonomic section has been written to provide enough information necessary for identification of the Australian mysid species. Definitions are given for all levels of classification. A key to the Australian genera in the Sub-Order Mysida is also included. Where only one species in a genus is known from Australia, a brief diagnosis of that species is included, otherwise a detailed key to the species within each genus is given. Figures and details of distributions are provided throughout (see also Chapter 3). Three new genera and 12 new species are described.

2.3.1 SUB-ORDER LOPHOGASTRIDA

Definition. Thoracic somites well defined dorsally. First pair of thoracic appendages developed as maxillipeds, robust; exopod slightly developed or

absent; epipod very large, projecting inside branchial chamber. Well-developed ramified branchiae present on thoracic appendages 2-7; rudimentary or absent on 8th pair. Female with 7 pairs of brood lamellae. Pleopods of both sexes well-developed, biramous, natatory and unmodified. Endopod of uropod without statocyst (Tattersall and Tattersall, 1951).
Remarks. Only one family is represented in Australian waters.

2.3.1.1 Family LOPHOGASTRIDAE

Definition. Carapace large, more or less calcareous. Abdominal segments with pleural plates. Distinct circular groove around circumference of last abdominal segment. Second pair of thoracic appendages developed as gnathopods; pairs 3-8 non-chelate (Tattersall and Tattersall, 1951).
Remarks. Evidence suggests that the Family Lophogastridae is the most primitive family in the Order Mysidacea. Characters such as 1) the circular groove on the last abdominal segment representing the incomplete fusion of the last two somites of the embryo (Manton, 1928); 2) presence of gills at the bases of the thoracic appendages; 3) absence of penes, and 4) the presence of well-developed pleopods in both sexes, indicate similarities to the fossil representatives of the Order Mysidacea (Tattersall and Tattersall, 1951).

There are six genera in the family (Mauchline, 1980); only Gnathophausia has been recorded from Australian waters.

i) Genus Gnathophausia Willemoes-Suhm, 1873

Diagnosis. Integument non-calcareous. Carapace large, shield-like with dorsal keel; rostrum spear-like, triangular in transverse section; strong median dorsal spine usually present on posterior margin. Abdominal segments with bilobed pleural plates. Endopod (palp) of maxillule 2-segmented reflexed backwards. Exopod of 1st thoracic appendage small or absent. Thoracic legs 2-8 almost uniform, biramous and not differentiated into series. Exopod of uropod broader than endopod, divided by a transverse sub-apical suture; outer margin of proximal segment terminated by a spine. Telson large, constricted near base; dorsal surface with two long keels; series of large spines with small spines in between arm the lateral borders. Apex armed with 2 strong curved spines joined at the base forming a backwardly directed crescent (Tattersall and Tattersall, 1951).
Remarks. Eight species are known in the genus (Mauchline, 1980). Ortmann (1906) provides a key for the separation of the species; synonyms however are still present in his key. Only one species, G.ingens, has been collected from Australian waters.

Gnathophausia ingens (Dohrn, 1870)

Synonyms. G.inflata Willemoes-Suhm, 1873
G.calcarata G.O. Sars, 1885
G.bengalensis Wood-Mason and Alcock, 1891
G.doryphora Illig, 1906

Diagnosis. Rostrum and carapace spines relatively short or obsolete in adults (Figs. 2.2A & B) but well-developed and comparatively long in juveniles (Fig. 2.2C). Dorsal keel of carapace interrupted. Lower lateral keel terminating in a spine at postero-inferior angle. Antennal scale small, sub-ovate; outer margin serrate; apex shortly pointed. Sixth abdominal segment with epimera united ventrally; together forming a cordiform concave plate with apical incision. Abdominal segments 2-5 with both lappets of epimera pointed and spiniform (Sars, 1885; Ortmann, 1906).

Remarks. A female of this species, measuring 35cm and caught between 2159-2654m depth from the Eastern Equatorial Pacific Ocean, represents the largest known individual mysid being more than 1.5 times larger than the previous largest individual collected (Clarke, 1961). It is important to stress that difficulties arise when identifying species, especially juvenile stages, due to the negative allometric growth of spines, in particular those of the carapace as shown in Fig. 2.2. Early workers (G.O. Sars, 1885) described the juveniles as a different species.

Known Distribution. 40°N-40°S, between 350-4000m depth (Mauchline and Murano, 1977).

Australian Records.

1) Fage (1941): Collected off the New South Wales coast.
2) O.S. Tattersall (1955): Station 1741. Date 18-4-1936 (Day). West of Perth, Western Australia; oblique tow 900-0m.
3) Unpublished record: From Hyperoglyphe antarctica (Trevalla) gut contents, collected by A.Cuthbertson 1978 in Tasmanian waters; 2 juveniles identified.
4) Unpublished record: Oblique tow RMT8 800-0m, 0100-0230hrs. Date 11-7-1984. Collected by J.Kalish south-east of Bruny Island, Tasmania 43°50'S 148°E; 2 juveniles identified.

2.3.2 SUB-ORDER MYSIDA

Definition. Carapace generally small; posterior margin exposing at least one thoracic segment. Branchiae absent. Second pair of thoracic appendages modified for feeding. Female with 2-3, rarely 7 pairs of brood lamellae. Female pleopods usually rudimentary; in male variable. Statocyst usually present on endopod of uropod (Tattersall and Tattersall, 1951).

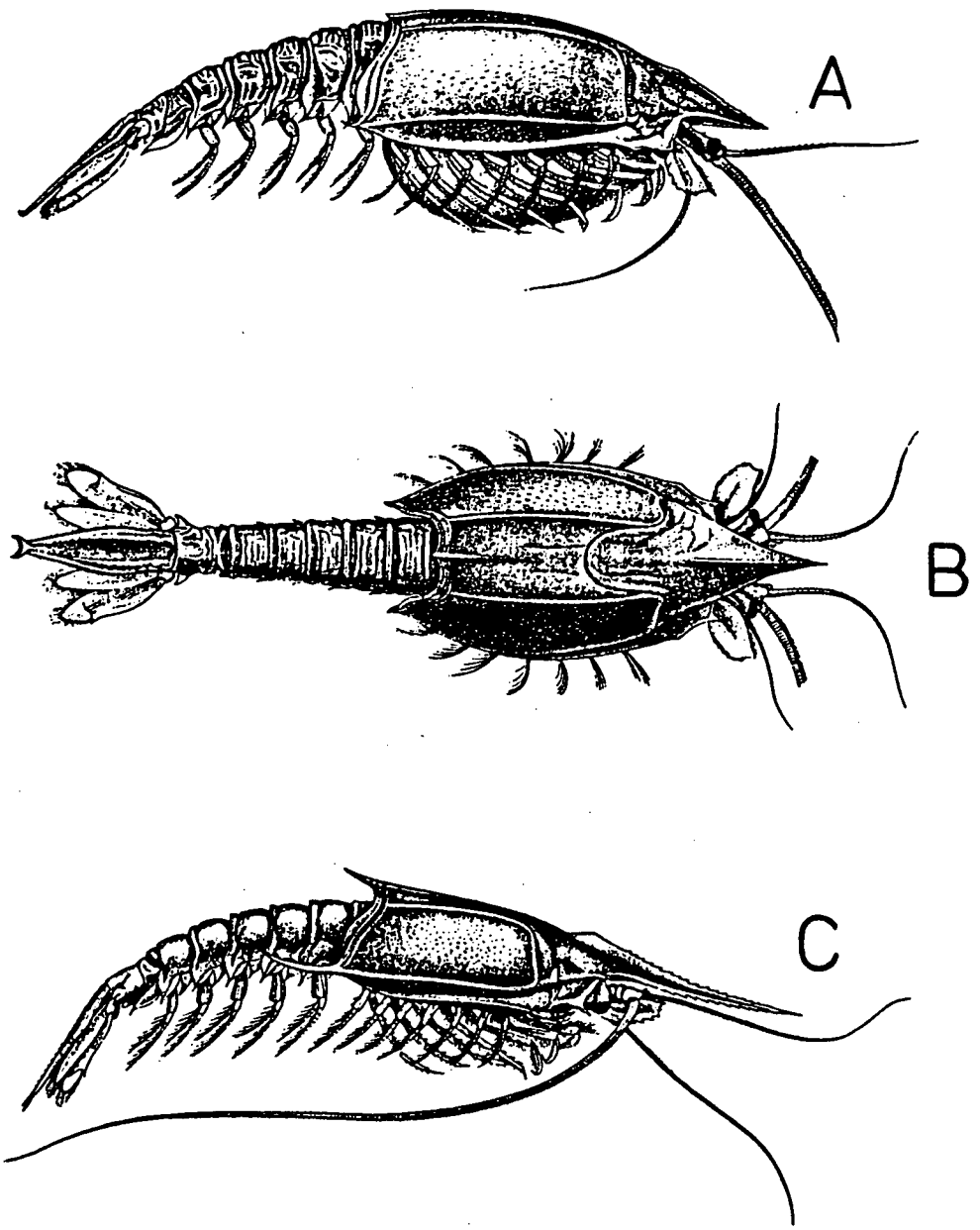
Fig. 2.2 Genus Gnathophausia

A G.ingens adult female, from right side 14.2cm; in length.

B G.ingens adult female, dorsal view.

C G.calcarata i.e. juvenile G.ingens.

(After G.O. Sars, 1885 Plate II, Figs. 1 and 2 and Plate IV Fig. 1 respectively).


A
B
C

Key to the Genera Known from Australia in the Sub-Order Mysida

1. Statocyst absent (Fig. 2.3A). Mandibular palp extremely elongated and modified (Fig. 2.3B & C). Family Petalophthalmidae. .... Petalophthalmus

--- Statocyst present. Mandibular palp not as above. Family Mysidae. 2

2. Female marsupium composed of 7 pairs of lamellae. Exopod of uropod divided proximally by an incipient articulation; outer border of proximal joint armed with a few spines but no setae. (Fig. 2.3D). Family Boreomysinae. ..... Boreomysis

--- Female marsupium composed of 2-3 pairs of lamellae. Exopod of uropod not as above. 3

3. Exopod of uropod divided into two segments by a distinct distal suture (Fig. 2.3E). 4

--- Exopod of uropod undivided. 6

4. Endopod of uropod with distinct distal suture. Exopod of uropod with setae but no spines on outer border (Fig. 2.3F). Sub-family Rhopalophthalminae. ..... Rhopalophthalmus

--- Endopod of uropod undivided. Exopod of uropod with spines but no setae on outer border. Sub-family Siriellinae. 5

5. Third pair of thoracic legs normal and similar to more posterior legs. ..... Siriella

--- Third pair of thoracic legs extremely elongated, almost twice as long as more posterior legs (Fig. 2.3G). ..... Hemisiriella

6. Outer margin of exopod of uropod with setae but no spines. 7

--- One to many spines but no setae (with the exception of Paranchialina) on outer margin of exopod of uropod (Fig. 2.4A). Sub-family Gastrosaccinae. 8

7. Labrum normal and symmetrical. First thoracic leg with distal margin of endopod normal and without spines. Sub-family Mysinae. 12

Fig. 2.3

A Petalophthalmus australis telson and uropods.
(After Dakin and Colefax, 1940 Fig. 219f, no scale provided).

B P.australis anterior of adult male; note elongated mandibular palp. (Scale 1.2cm drawn = 0.5mm).
(After Panampunnayil, 1982 Fig. 2).

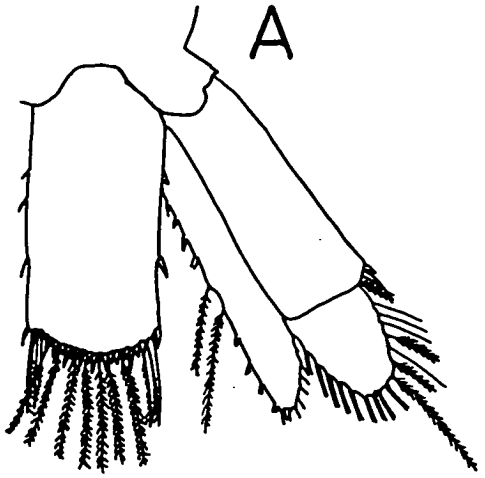
C P.australis mandibular palp.
(After Dakin and Colefax, 1940 Fig. 219a, no scale provided).

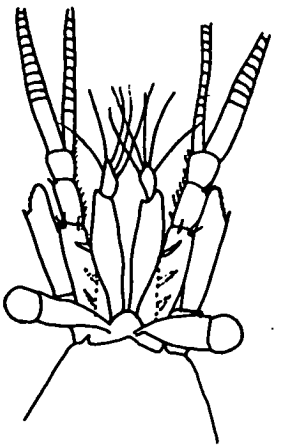
D Boreomysis sibogae exopod of uropod x11
(After Hansen, 1910 Plate II, Fig. 3d).

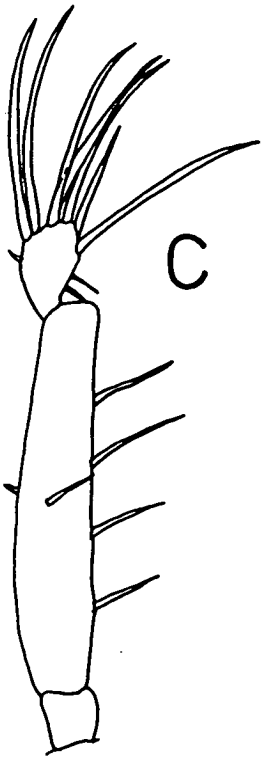
E Siriella longidactyla uropods x49; note exopod with distinct distal suture.
(After W.M. Tattersall, 1940 Fig. 1b).

F Rhopalophthalmus dakini telson and uropods x25.
(After O.S. Tattersall, 1957 Fig. 3L).

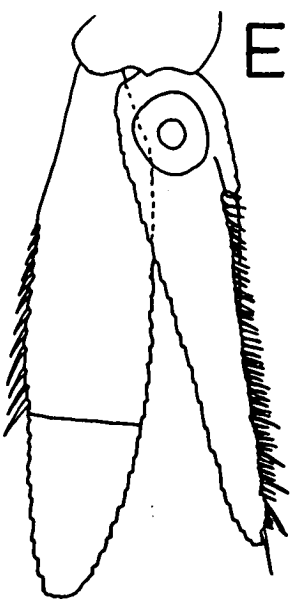
G Hemisiriella parva lateral view of adult male x10; note elongated third thoracic limb.
(After Ii, 1964 Fig. 42B).

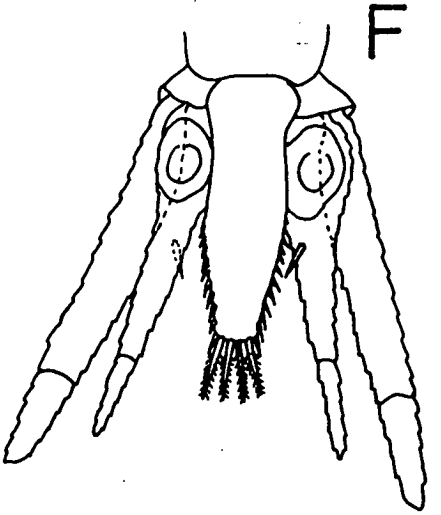

A


B


C


D


E


F

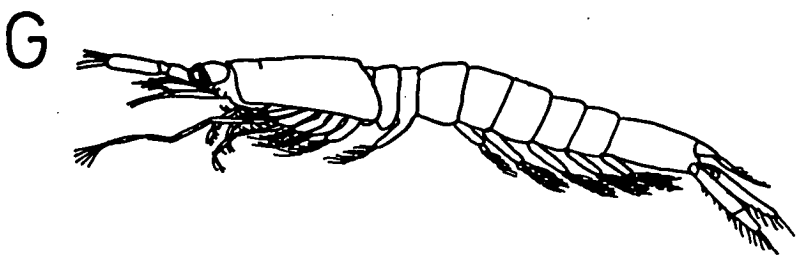

G

Fig. 2.4

A H.(G.)dakini uropods x49; note exopod with spines and no setae.
(After W.M. Tattersall, 1940 Fig. 3b).

B Mysidella sp.1 n.sp. labrum.

C M.sp.1 n.sp. distal margin of first thoracic limb.

D Pseudanchialina inermis telson and uropods.
(After Pillai, 1973 Fig. 37B; no scale provided)

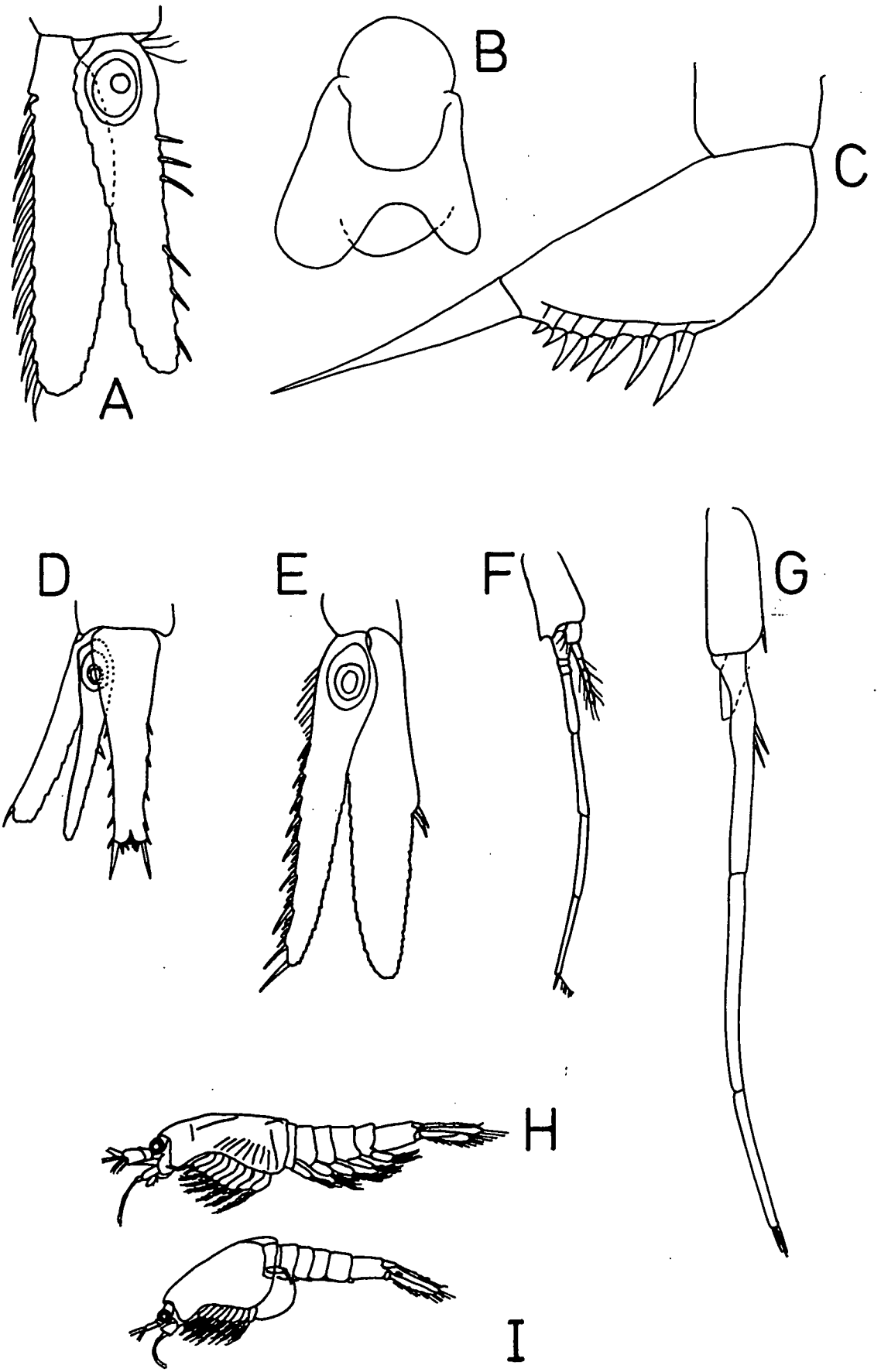
E Paranchialina angustus uropods.
(After G.O. Sars, 1885 Plate XXXV, Fig. 18 as Anchialus angustus; no scale provided).

F Gastrosaccus daviei third male pleopod.
(Scale 2.3cm drawn = 0.5mm).
(After Bacescu and Udrescu, 1982 Fig. 1I).

G H.(G.)indicus third male pleopod x42.
(After W.M. Tattersall, 1940 Fig. 2f).

H Anchialina typica adult male lateral view x9.5.

I A.typica adult female lateral view x9.5.
(Figs. H and I after Ii, 1964 Fig. 48 C and D, respectively).


A
B
C
D
E
F
G
H
I

--- Labrum asymmetrical posteriorly produced into 2 unequal lobes (Fig. 2.4B). First thoracic leg with distal margin of endopod armed with spines (Fig. 2.4C). Sub-family Mysidellinae. .... Mysidella

8. Outer margin of exopod of uropod with 1 or 2 spines. 9
--- Outer margin of exopod of uropod with more than 5 spines. 10

9. Outer margin of exopod of uropod non-setose with one terminal spine (Fig. 2.4D). ..... Pseudanchialina
--- Outer margin of exopod of uropod marked distally by 2 spines; proximal margin non-setose, distal margin setiferous (Fig. 2.4E). ..... Paranchialina

10. Endopod of third male pleopod composed of many segments (Fig. 2.4F). 11
--- Endopod of the third male pleopod unsegmented (Fig. 2.4G). .... Haplostylus

11. Posterior margin of carapace transverse. Spines on outer margin of outer uropod small. Third to eighth thoracic limbs with distinct carpus; propodus sub-divided into 2-3 segments. Pleural plates of first abdominal segment in female small (Fig. 2.4H). Female pleopods 1-5 uniramous. Exopod of male pleopod 3 slightly elongated (Fig. 2.4I). ..... Anchialina
--- Posterior margin of carapace deeply emarginate. Spines on outer margin of outer uropod large. Third to eighth thoracic limbs with fused carpo-propodus sub-divided into more than 6 segments. Pleural plates of first abdominal segment in female enlarged greatly, forming part of the brood pouch. Female pleopod 1 biramous, pleopods 2-5 uniramous. Exopod of male pleopod 3 greatly elongated (Fig. 2.4F). ..... Gastrosaccus

12. Third thoracic leg strongly thickened with carpus and propodus undivided, thickened and armed with spines (Fig. 2.5A). Tribe Heteromysini. 13
--- Third thoracic leg normal and similar to more posterior legs, with propodus or fused carpo-propodus sub-divided. 14

Fig. 2.5

A Heteromysis stellata endopod of third thoracic limb. (Scale 2cm drawn = 0.5mm).
(After Bacescu and Bruce, 1980 Fig. 2E).

B Heteromysoides longiseta anterior of female.
(Scale 3.2cm drawn = 0.5mm)
(After Bacescu, 1983 Fig. 1A).

C Pseudomma australe anterior of male, dorsal view.

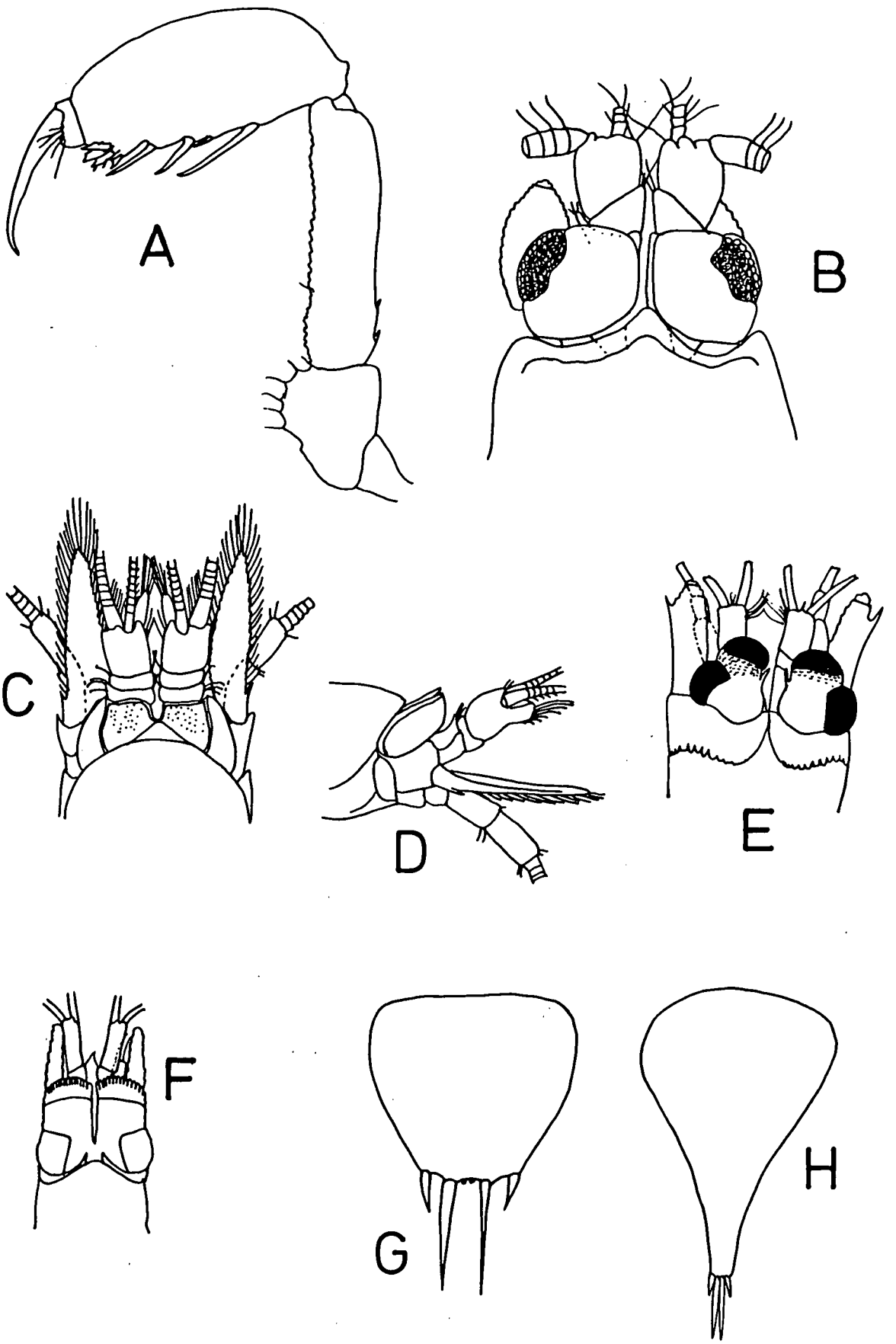
D P.australe anterior of male, lateral view.
(Figs. C & D after G.O. Sars, 1885 Plate XXXIII, Figs. 17 & 18).

E Euchaetomera typica anterior of adult female x 15.
(After Ii, 1964 Fig. 92A).

F Euchaetomeropsis merolopsis anterior end of adult female, X19.
(After Murano, 1977, Fig. 5a).

G Erythrops yongei telson, median setae broken x112.
(After W.M. Tattersall, 1936a Fig. 2b)

H Katerythrops oceanae telson x50.
(After Ii, 1964 Fig. 80I).


A
B
C
D
E
F
G
H

13. Eyes basically quadrangular in shape, with cornea in antero-lateral region of eyestalk (Fig. 2.5B). ..... Heteromysoides
--- Eyes spherical or tubular; cornea symmetrical with respect to the eyestalk. ..... Heteromysis

14. Endopods of third to eighth thoracic legs with undivided carpus marked off from propodus by an oblique articulation. Antennal scale with outer margin non-setose, nearly always with a pronounced external spine (setose and without spine in Euchaetomeropsis). Pleopods 2-5 of male well-developed and biramous. Telson entire. Tribe Erythropini. 15
--- Endopods of third to eighth thoracic legs with carpus and propodus fused and sub-divided. Telson and antennal scale variable. 23

15. Eyes well-developed, more or less spherical in shape. 16
--- Eyes rudimentary, plate-like (Fig. 2.5C & D). ..... Pseudomma

16. Visual elements of eye divided into two distinct portions. 17
--- Visual elements of eye undivided. 18

17. Antennal scale with outer margin non-setose with distal spine (Fig. 2.5E). ..... Euchaetomera
Antennal scale setose all round (Fig. 2.5F). ..... Euchaetomeropsis

18. No spines present on lateral margins of telson. 19
--- Spines arming at least part of lateral margin of telson. 20

19. Telson shorter than broad; apex armed with 4 strong spines and 1 pair of plumose setae (Fig. 2.5G). ..... Erythrops
--- Telson short, triangular with narrowly truncate apex. Apex armed with 4 spines but no plumose setae (Fig. 2.5H). ..... Katerythrops

20. Telson longer than broad; apex truncate armed with 6 spines, innermost spine minute, together with a pair of plumose setae. Lateral margins of telson armed with spines along entire length (Fig. 2.6A). ..... Hypererythrops

Fig. 2.6

A Hypererythrops spinifera telson, plumose setae broken x45.
(After Ii, 1964 Fig. 85H).

B Australerythrops paradicei telson x50.
(After W.M. Tattersall, 1928 Fig. 30E).

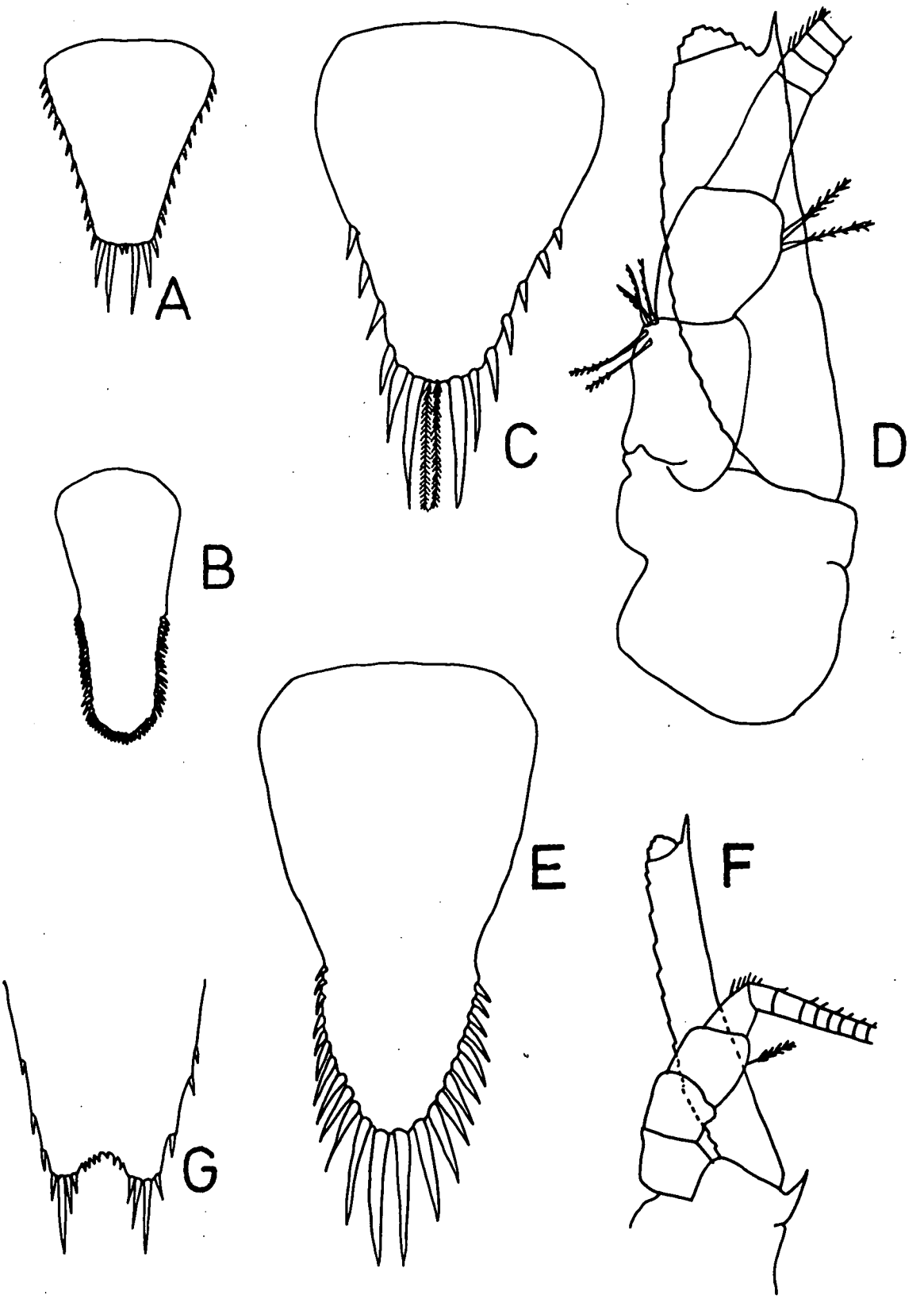
C Synerythrops intermedia telson, plumose setae broken x94.

D S.intermedia antennal scale x94.
(Figs. B & C after W.M. Tattersall, 1936a Figs. 3b & a, respectively).

E Gibberythrops stephensoni telson x112 (plumose setae absent).

F G.stephensoni antennal scale x56.
(Figs. E & F after W.M. Tattersall, 1936a Fig. 4b & a, respectively).

G Mysidetes halope telson.
(After O'Brien in press).


A
B
C
D
E
F
G

--- Lateral margins of the telson partially armed with spines. .....
..... 21

21. Apex of telson without plumose setae. Telson linguiform, distal half of telson and apex armed with numerous small spines (Fig. 2.6B). ..... Australerythrops
--- Apex of telson with plumose setae and 1-2 pairs of large spines.
..... 22

22. Telson without constriction (Fig. 2.6C). Antennal scale approximately 1/3 longer than antennal peduncle (Fig. 2.6D). .....
..... Synerythrops
--- Telson with constriction at approximately 2/3 of its length (Fig. 2.6E). Antennal scale twice as long as antennal peduncle (Fig. 2.6F). ..... Gibberythrops

23. Pleopods 2-5 of male well-developed and biramous (rudimentary in Pseudomysidetes and Mysidetes). Antennal scale setose all round. Tribe Leptomysini. 24
--- At least pleopod 2 of male is rudimentary and uniramous; exopod of pleopod 4 elongated and modified. Tribe Mysini. 32

24. Pleopods of male rudimentary as in female. 25
--- Pleopods of male well-developed and biramous. 26

25. Telson with apical cleft (Fig. 2.6G). Thoracic legs long and slender. ..... Mysidetes
--- Telson long and narrowly lanceolate in shape (Fig. 2.7A). Thoracic legs 3-8 show a progressive reduction in length of endopod. ..... Pseudomysidetes

26. Ventral surface of telson with numerous plumose setae. 27
--- Ventral surface of telson without plumose setae. 28

27. Telson triangular, entire; lateral margins armed with spines along proximal 2/3 of telson; apex with 2 spines (Fig. 2.7B). Dorsal surface of carapace with prominent dorsal fin. Mandibular palp with spines on median and distal segments. .....
..... Allomysis n.g.

Fig. 2.7

A Pseudomysidetes russelli telson x56.
(After W.M. Tattersall, 1936a Fig. 7j).

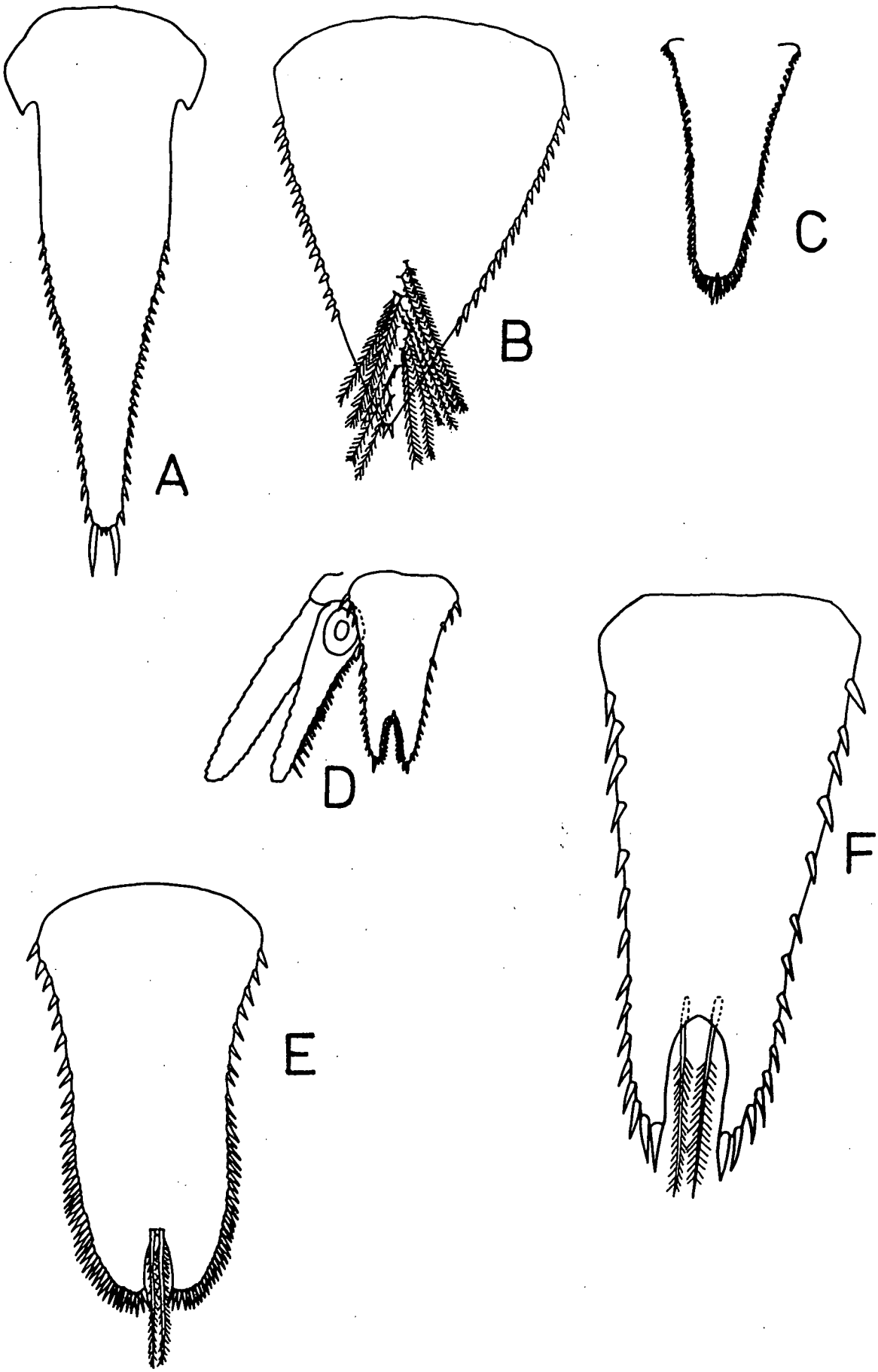
B Allomysis sp.1 n.g. telson.

C Leptomysis australiensis telson.
(Adapted from W.M. Tattersall, 1927 Fig. 100h)

D Australomysis incisa telson and uropods 38 diam.
(After W.M. Tattersall, 1927 Fig. 101b).

E Prionomysis sp.1 n.sp. telson.

F Promysis orientalis telson x112.
(After W.M. Tattersall, 1936a Fig. 5e).


A
B
C
D
E
F

--- Telson narrowly linguiform with minute apical cleft (Fig. 2.7C). Carapace without prominent dorsal fin. Mandibular palp without spines. ..... Leptomysis/Notomysis

28. Cleft of telson with spines but no plumose sétae (Fig. 2.7D). ... . Australomysis
--- Cleft of telson with a pair of plumose setae; spines may or may not be present. 29

29. Cleft of telson not armed with spines. 30
--- Cleft of telson armed with spines. 31

30. Telson with several spines arming each apical lobe (Fig. 2.7E). ..... Prionomysis
--- Telson with one spine arming each apical lobe (Fig. 2.7B). .... Promysis

31. Labrum with prominent spiniform process. ..... Iimysis
--- Labrum without spiniform process. 32

32. Telson with at least one large spine on each apical lobe (Fig. 2.8A). Distal segment of maxilla rectangular (Fig. 2.8B). ..... Tenagomysis
--- Apical lobes of telson rounded with several large spines (Fig. 2.8C). Distal segment of maxilla triangular (Fig. 2.8D). .. .. Doxomysis

33. Antennal scale with non-setose outer margin without prominent distal spine (Fig. 2.8E). Body characteristically shaped as in Fig. 2.8F. Fourth male pleopod with exopod unsegmented. .... Idiomysis
--- Antennal scale setose along lateral and medial borders. Body not flexed as above. Exopod of fourth male pleopod segmented. 34

34. Male pleopods 1 and 2 rudimentary. Pleopod 3 with exopod and endopod composed of 3 and 2 segments respectively. Pleopod 4 with single segmented endopod and 5-segmented exopod (Fig. 2.9A). Pleopod 5 with unsegmented endopod and exopod 2-segmented. Telson shallowly cleft (Fig. 2.9B). ..... Tasmanomysis n.g.

Fig. 2.8

A *Tenagomysis* sp.2 n.sp. male telson.

B *T.*sp.2 n.sp. terminal segment of maxilla.

C *Doxomysis* sp.1 n.sp. telson.

D *D.*sp.1 terminal segment of maxilla.

E *Idiomysis inermis* antennal scale x65.

F *I.inermis* adult male, lateral view x21.

(Figs. E & F after W.M. Tattersall, 1922 Fig. 23c & a, respectively).

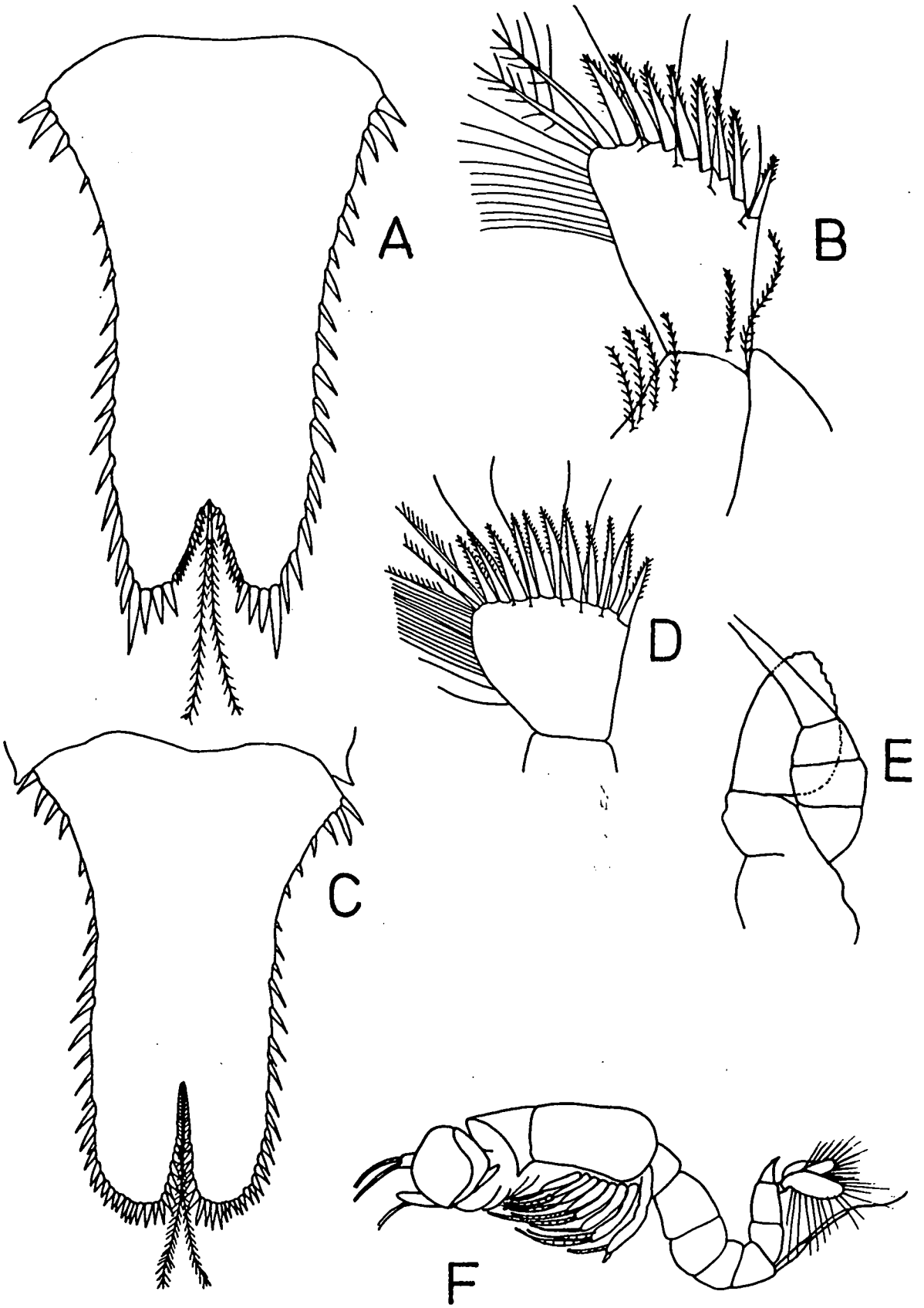

A
B
C
D
E
F

Fig. 2.9

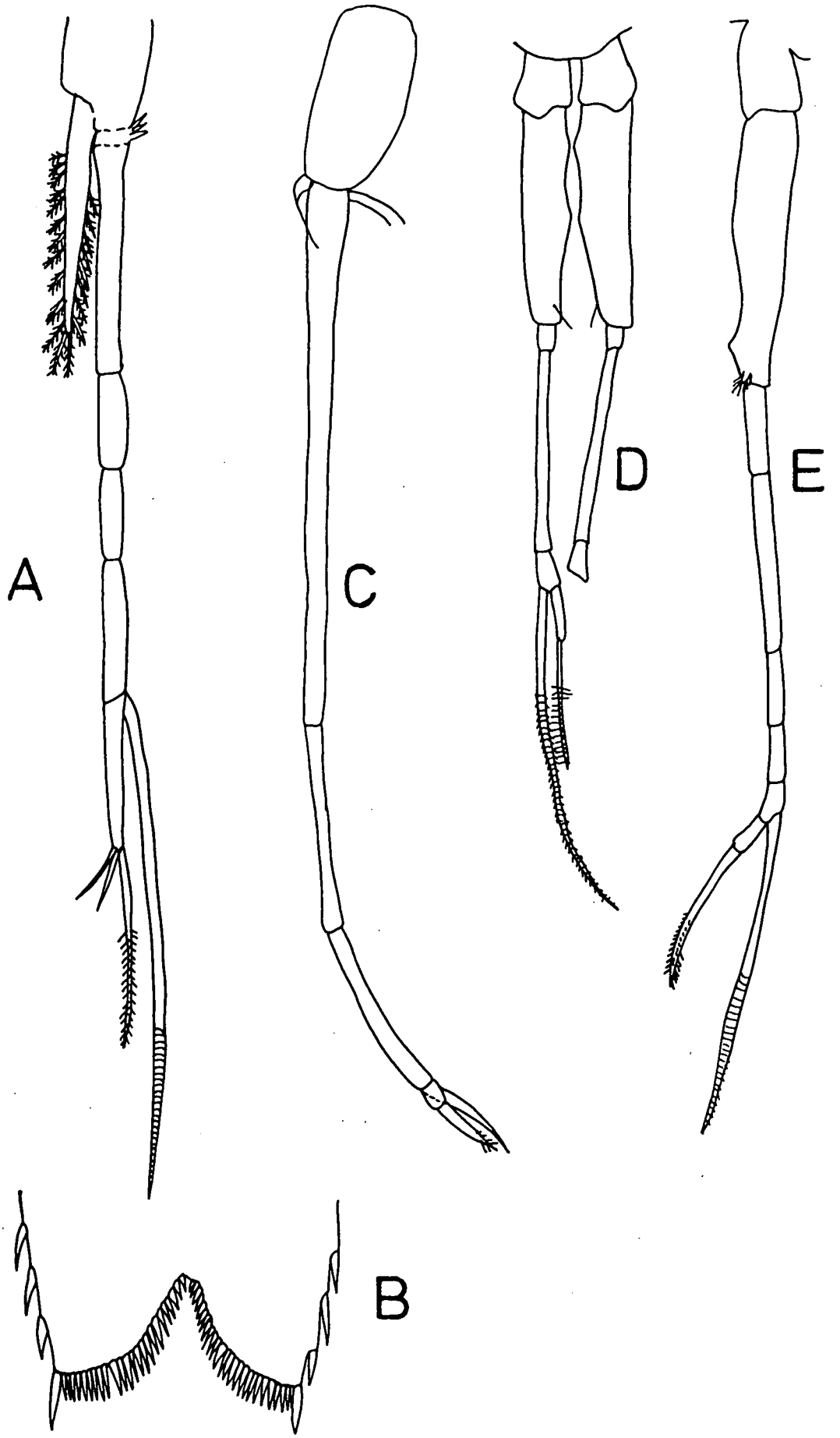
A Tasmanomysis oculata n.g. n.sp. pleopod 4.

B T.oculata n.g. n.sp. distal end of telson.

C Anisomysis incisa pleopod 4 x134.
(After W.M. Tattersall, 1936a Fig. 9f).

D Halemysis australiensis pleopod 4 (Scale 2.7cm = 0.3mm).
(After Bacescu and Udrescu, 1984 Fig. 2e).

E Paramesopodopsis rufa n.g. n.sp. pleopod 4.


A
B
C
D
E

--- Male pleopods 1, 2 and 5 rudimentary as in female. Telson may or may not be cleft but not as above. 35

35. Only pleopod 4 of male developed; exopod composed of 4 segments (Fig. 2.9C). Telson variable. ..... Anisomysis
--- Pleopods 3 and 4 of male developed. Apex of telson broadly rounded, armed with small spines. 36

36. Exopod of pleopod 4 composed of 7 segments (Fig. 2.9D). .....
..... Paramesopodopsis
--- Exopod of pleopod 4 composed of 5 segments (Fig. 2.9E). .....
..... Halemysis

2.3.2.1 Family PETALOPHTHALMIDAE

Definition. Carapace membranous, short, leaving last 2 thoracic segments exposed. Maxillule without palp. First thoracic appendage without exopod. Lamella-like expansion present on merus of 2nd thoracic limb. Thoracic legs 3-8 with penultimate segment undivided. Female brood pouch formed by 7 pairs of brood lamellae. Pleopods of female slender, usually uniramous. Male pleopods biramous, natatory and robust. Exopod of uropod with distinct distal segment. Endopod without statocyst (Tattersall and Tattersall, 1951).

Remarks. This family is considered to be the most primitive of the sub-order Mysida. The primitive characters include the presence of 7 pairs of brood lamellae, the undivided propodus of the thoracic legs, the biramous natatory male pleopods, the slight development of female pleopods and the absence of a statocyst in the endopod of the uropod (Tattersall and Tattersall, 1951).

Three genera are known in this family; only the genus Petalophthalmus is represented in Australian waters.

i) Genus Petalophthalmus Willemoes-Suhm, 1874

Diagnosis. Body elongated. Carapace short, membranous; rostrum short, flanked by a pair of small tooth-like projections; anterior margin of carapace more or less concave. Antennular peduncle very long; with two flagella; outer flagella slender compared to inner one in female; in male outer flagella proximally enlarged, and thicker than inner flagella. Antennal scale narrowly lanceolate, setose along lateral and medial borders

or outer margin straight, naked with terminal spine (P.australis). Eyes may or may not be developed; papilla sometimes present. Mandibles with lacinia mobilis reduced, spine row absent; palp enormous, long and prehensile. Maxilla with small basal lobe without setiferous expansion; distal lobe small or expanded (P.australis). First thoracic appendage robust, with large delicate epipod; exopod absent. Second thoracic appendage similar to first, exopod absent; ischium with large quadrangular lobe. Thoracic legs 3-8 slender; long delicate nail. Male pleopods biramous, natatory; female pleopods uniramous or biramous, non-natatory (P.caribbeanus and P.australis). Uropods: exopod 2-segmented, proximal margin naked terminating in 1-3 spines; endopod without spines. Telson large, quadrangular, entire, apex truncate or slightly emarginate; lateral borders with spines (Panampunnayil, 1982).

Remarks. Four species are known (Panampunnayil, 1982); only one has been recorded from Australian waters.

Petalophthalmus australis Panampunnayil, 1982

Synonym. Petalophthalmus sp. Dakin and Colefax, 1940.

Diagnosis. Eyes well-developed and elongated. Antennal scale broad, outer margin straight, naked with terminal spine beyond which apical lobe extends (Fig. 2.3B). Terminal segment of mandibular palp short, only 1/4 length of penultimate segment; 7 spines arm terminal segment (Fig. 2.3C). Third segment of maxilla with expanded setiferous lobe. Lateral margins of telson with 4 spines; apex truncate with spines arranged in series (Fig. 2.3A). Female pleopods biramous.

Known Distribution. Australian waters.

Australian Records.

1) Dakin and Colefax (1940): Off Broken Bay, N.S.W. 20 fathoms.
2) Panampunnayil (1982): West coast of Australia between 30°16'S 114°51'E and 35°10'S 118°35'E surface and sub-surface hauls at night.
3) National Museum of Victoria Bass Strait Survey: Stations 120, 156, 164, 183 and 202.

2.3.2.2 Family MYSIDAE

Definition. Maxillule without palp. First thoracic appendage usually with well-developed exopod. Second thoracic appendage without lamella-like expansion of merus. Carpus and propodus of thoracic legs 3-8 fused and subdivided into sub-segments. Brood pouch formed by 2-3, rarely 7 pairs of brood lamellae. Female pleopods usually rudimentary plate-like, rarely

biramous. Male pleopods either well-developed, biramous or one or more pairs reduced as in female and one or more pairs modified as accessory sexual appendages. Statocyst present on endopod of uropod (Tattersall and Tattersall, 1951).

Remarks. This family is further divided into the following 6 sub-families: Boreomysinae, Siriellinae, Rhopalophthalminae, Gastrosaccinae, Mysinae and Mysidellinae; all are known from Australian waters.

2.3.2.2.1 Sub-Family BOREOMYSINAE

Definition. Labrum broader than long, without frontal spine. Carpus of thoracic legs 3-8 distinct, propodus divided into 2-3 sub-segments. Male pleopods biramous, well-developed, exopod of second and third pairs elongated, at least one pair modified distally. Female brood pouch formed by 7 pairs of lamellae. Exopod of uropod with a rudimentary transverse articulation close to the base of the exopod, marked off by 1-2 spines; outer margin naked above articulation, setose below. Telson with apical cleft lined with spines (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. Only one genus belongs in this sub-family.

i) Genus Boreomysis G.O. Sars, 1869

Diagnosis. Antennal scale with outer margin naked, terminating in a strong spine; apex of scale truncate with small oblique distal suture. Maxilla with setose posterior expansion of lobe arising from second segment; terminal segment of palp expanded. First thoracic appendage with gnathobasic lobes on second and third segments of endopod. Second thoracic leg with short, stout and densely setose terminal segment. Statocyst small (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. Mauchline (1980) lists 36 species in the genus Boreomysis; only one species has been collected in Australian waters.

Boreomysis sibogae Hansen, 1910

Diagnosis. Eyes normally developed; as long as broad. Rostral process relatively short with moderately large median spine; distinct shoulders on the margins. Apical cleft of telson occupies approximately 1/4 length of telson; no dilation at base (Ii, 1964).

Remarks. A positive identification at the species level is difficult due to the poor condition of the specimens, however the features listed above are exhibited.

Known Distribution. Widely distributed in the Pacific, Indian, Mid-Atlantic

and Southern Oceans (Ii, 1964) including: Dutch East Indies (Hansen, 1910); Indian Ocean off Ras Mafun (Illig, 1930); Red Sea (Coifmann, 1936); Japan (W.M. Tattersall, 1951); West of Cape Town, Mid-Atlantic near equator, South Georgia (O.S. Tattersall, 1955); Arabian Sea (W.M. Tattersall, 1939).

Australian Records.

1) From Cyttus traversi (King Dory) stomach, collected by CSIRO Division of Fisheries Research off Maria Island, Tasmania. 2 individuals.

2.3.2.2.2 Sub-Family SIRIELLINAE

Definition. Antennal scale with outer margin naked terminated by a strong spine. Eyes well-developed. Labrum longer than broad, anteriorly bearing a long spine (except for S.lingvura). Carpus of thoracic legs 3-8 distinct; propodus undivided or divided into 2-3 sub-segments terminating in a characteristic tuft of long unusually serrated setae surrounding the dactylus. Male pleopods well-developed, natatory, with biramous pseudobranchiae. Pleopods 2-5 biramous, pleopod 1 without endopod. Female brood pouch formed by 3 pairs of lamellae. Exopod of uropod with distinct distal suture; outer margin of proximal segment with some spines but no setae (except for S.dubia in which both spines and plumose setae are present) (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. Both genera belonging to this sub-family are represented in Australian waters.

i) Genus Hemisiriella Hansen, 1910

Diagnosis. Endopod of third thoracic leg extremely elongated, almost twice as long as thoracic legs 4-8; dactylus rudimentary. Antennal scale shorter than antennular peduncle. Pleopods of male without modified setae; pleopods 2-4 with spirally twisted pseudobranchiae. Telson and uropods almost as in Siriella (Tattersall and Tattersall, 1951; Ii, 1964).

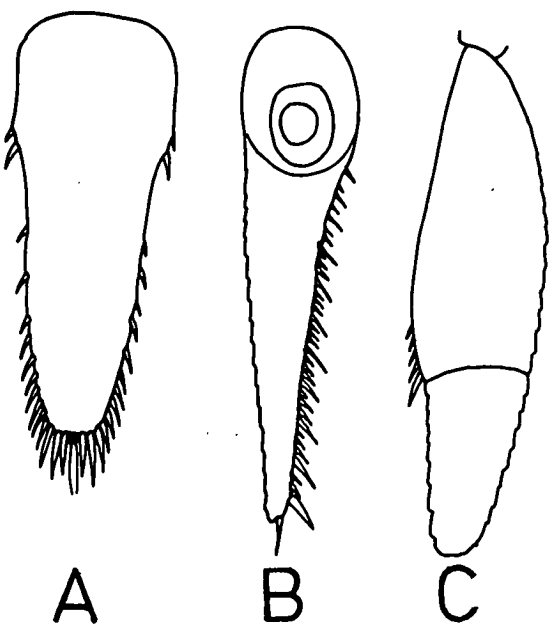
Remarks. Four species are listed by Mauchline (1980); H.pulchra, H.parva, H.abbreviata and H.gardineri. However, both Ii (1964) and Pillai (1973) rejected the validity of H.abbreviata. Two species have been collected in Australian waters.

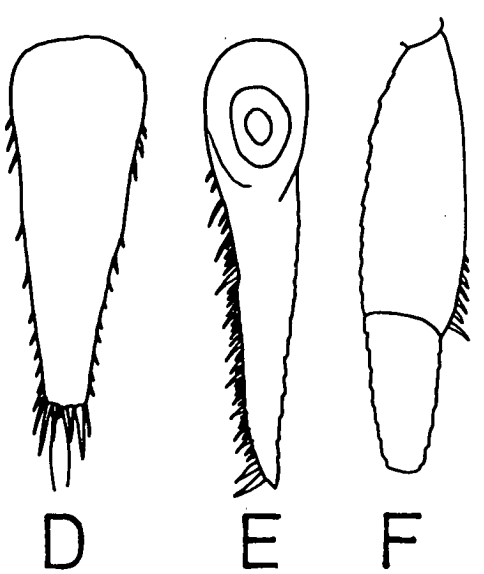
Key to the Australian Species of Hemisiriella

1. Telson with constriction and 2 pairs of spines present near base (Fig. 2.10A). Endopod of uropod as long or slightly longer than exopod (Figs. 2.10B and C). ..... H.pulchra

Fig. 2.10 Genus Hemisiriella

A Hemisiriella pulchra adult male telson x45.
B H.pulchra endopod of uropod of same male x45.
C H.pulchra exopod of uropod of same male x45.
(Figs. A, B & C after Ii, 1964 Fig. 41A, K & L, respectively).
D H.parva adult male telson x45.
E H.parva endopod of uropod of same adult male x45.
F H.parva exopod of uropod of same adult male x45.
(Figs. D, E & F after Ii, 1964 Fig. 43F, L & N, respectively).


A
B
C


D
E
F

--- Telson lacks constriction, narrows steadily towards apex; base of telson with 3 pairs of spines (Fig. 2.10D). Endopod of uropod longer than exopod (Figs. 2.10E and F). .... H.parva

Hemisiriella parva Hansen, 1910

Diagnosis. Ii, 1964; Pillai, 1973.

Known Distribution. Oceanic 20°N-20°S (Mauchline and Murano, 1977) including: East Indies (Hansen, 1910); Indian Ocean (Colosi, 1919 & 1920); Java (Zimmer, 1918; Delsman, 1939); Andaman Islands (W.M. Tattersall, 1922); Philippine Islands (W.M. Tattersall, 1951); South China Sea (Ii, 1964).

Australian Records.

1) W.M. Tattersall (1936a): Station 1, 3 miles east of Low Isles, Great Barrier Reef, 27-7-1928, coarse tow-net, 1 immature female.
2) Pillai (1973): West coast of Australia, Station 748.

H.pulchra Hansen, 1910

Diagnosis. Ii, 1964; Pillai, 1973.

Known Distribution. Oceanic 33°N-7°S (Mauchline and Murano, 1977) including: East Indies (Hansen, 1910); East China Sea and Yellow Sea (Ii, 1964).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, 3 miles east of Low Isles: Station 21, 22-10-1928, 1m stramin net at night, 1 female and 2 juveniles; station 65, 10-7-1929, tow-net at night, abundant in upper layers of water.
2) Pillai (1973): West coast of Australia, Stations 218, 224, 235, 237 and 238.

ii) **Genus Siriella** Dana, 1850

Diagnosis. Antennal scale with outer margin naked, terminating in a stout spine; suture forming distal segment may or may not be present. Male pleopods with well-developed pseudobranchiae either straight or spirally twisted. Pleopod 1 uniramous, pleopods 2-5 biramous; distal setae on third and or fourth pairs frequently modified. Telson entire, always armed with 3 (4 in S.armata) small spines and a pair of plumose setae between 1-2 pairs of stout spines (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. The genus Siriella is recognized as a difficult one comprising

over 50 species. Separation of species, although easy for males, by differences in the form of the pleopods, is often difficult for females. There are 17 species known from Australia; the following key for their identification unavoidably is based on males but where possible characters common to both sexes are provided.

Key to the Australian Species of Siriella

1. Pseudobranchial rami on pleopods 2-4 spirally coiled or at least C-shaped (Fig. 2.11A). 2
--- Pseudobranchial rami on pleopods 2-4 straight (Fig. 2.11B). 15

2. Setae on male pleopods unmodified. 3
--- Terminal setae on pleopods 4, or pleopods 3 and 4 modified. 13

3. Exopod of uropod with spines confined to distal half of margin. 4
--- Exopod of uropod with 12 spines extending proximally well beyond mid-way along outer margin (Fig. 2.11C). Thoracic limbs with exceedingly long dactylus (Fig. 2.11D). ..... S.longidactyla

4. Exopod of uropod shorter than endopod. 5
--- Exopod of uropod same length or longer than endopod. 6

5. Telson with 2 pairs of stout spines at apex. (Fig. 2.11E). Eyes large (Fig. 2.11F). Antennal scale long and slender (Fig. 2.11G). ..... S.thompsonii
--- Telson with 1 pair of stout spines at apex. (Figs. 2.11H & K). Eyes small (Fig. 2.11I). Antennal scale short and broad (Fig. 2.11J). ..... S.gracilis

6. Antennal scale without distal articulation. 7
--- Antennal scale with distal articulation. 9

7. Telson with single pair of spines at base (Fig. 2.12A). Endopod of 5th thoracic leg elongated, 2/3 longer than 3rd thoracic endopod. Female carapace with protuberances. Eyes on short eyestalks (Fig. 2.12B). ..... S.nodosa

Fig. 2.11 Genus Siriella

A Pseudobranchial rami spirally coiled x24.
(After Hansen, 1910 Plate IV, Fig. 2c).

B Pseudobranchial rami straight x24.
(After Hansen, 1910 Plate V, Fig. 1e).

C Siriella longidactyla uropods x49.

D S.longidactyla 8th thoracic limb of male x49.
(Figs. C & D after W.M. Tattersall, 1940 Fig. 1b & d, respectively).

E S.thompsonii male telson and uropod.
(After Pillai, 1973 Fig. 10B, no scale provided).

F S.thompsonii anterior of adult male x26.

G S.thompsonii antennal scale and peduncle of female x11.
(Figs. F & G after Ii, 1964 Fig. 14C & F, respectively).

H S.gracilis telson and uropods x35.

I S.gracilis anterior of adult male x25.

J S.gracilis antennal scale and peduncle of female x45.

K S.gracilis apex of telson x95.
(Figs. H, I, J & K after Ii, 1964 Fig. 16H, B, D & J, respectively).

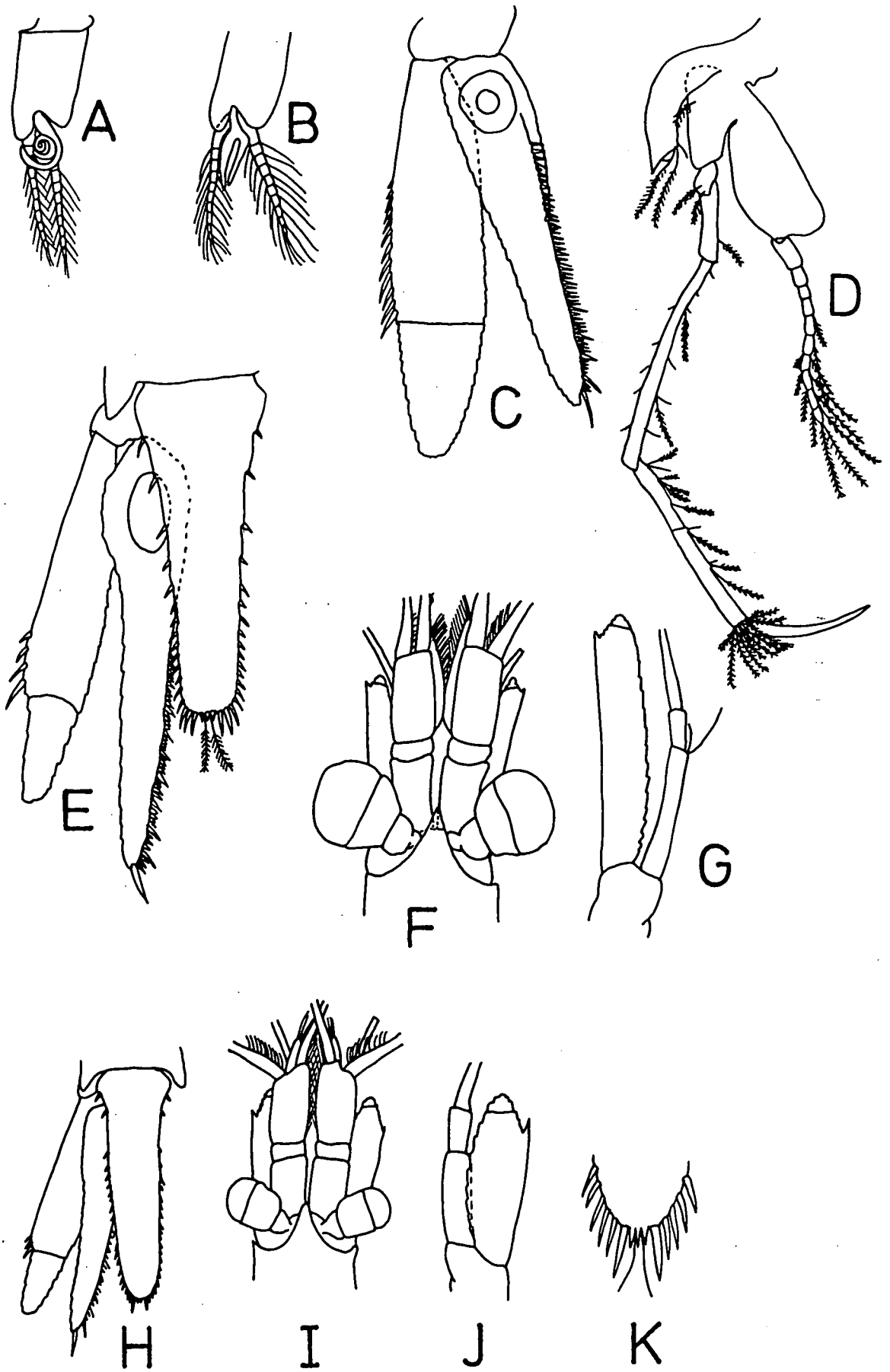

A
B
C
D
E
F
G
H
I
J
K

Fig. 2.12 Genus Siriella

A S.nodosa female telson and uropod x52.

B S.nodosa anterior of male x33.

(After Hansen, 1910 Plate III, Fig. 1h & a, respectively).

C S.vincenti dorsal view of anterior end of female x39.

D S.vincenti third thoracic limb x39.

E S.vincenti telson and uropod x39.

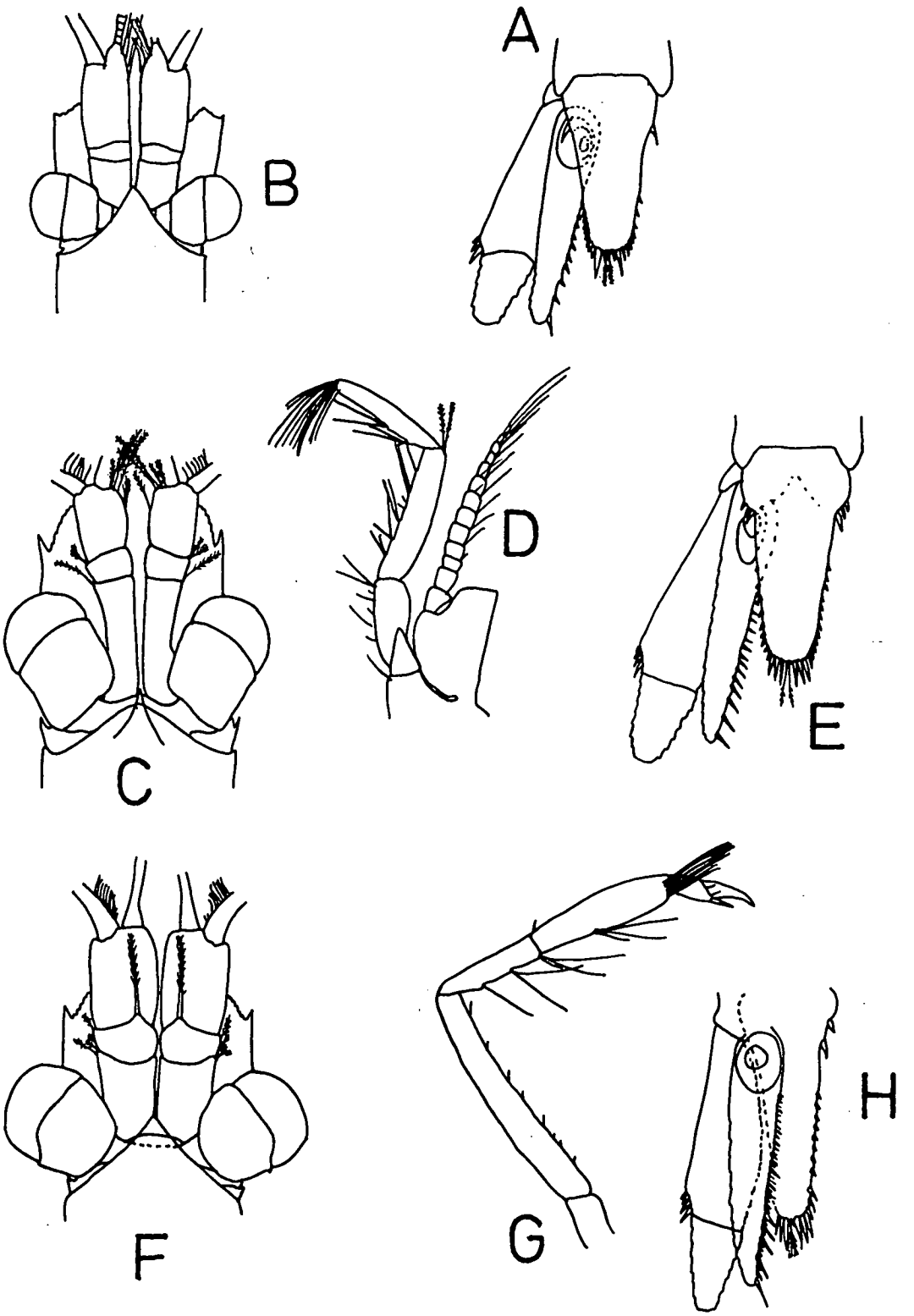
(Figs. C, D & E after W.M. Tattersall, 1927 Fig. 97a, e & f respectively).

F S.australis dorsal view of anterior end of female x22.

G S.australis endopod of third thoracic limb x50.

H S.australis telson and uropod x39.

(Figs. F, G & H after W.M. Tattersall, 1927 Fig. 98, Fig. 99d & e respectively).


A
B
C
D
E
F
G
H

--- Telson with more than 1 pair of spines at base. Endopod of 5th thoracic leg not elongated as above. Female carapace without protuberances. Eyestalks short of elongated. 8

8. Rostral plate rounded with prominent pseudo-rostral process beneath; antennular peduncle and eyes slightly elongated (Fig. 2.12C). Sixth segment of thoracic endopods 3-8 unsegmented (Fig. 2.12D). Telson broadly linguiform, generally with 3 pairs of spines at base; spines not arranged in groups on inner margin of endopod of uropod (Fig. 2.12E). ..... S.vincenti

--- Rostral plate acute, triangular; no pseudo-rostral process; antennular peduncle and eyes short and stout (Fig. 2.12F). Sixth segment of thoracic endopods 3-8 divided into 2 sub-segments (Fig. 2.12G). Telson narrowly linguiform, generally with 2 pairs of spines at base; spines arranged in groups on inner margin of endopod of uropod (Fig. 2.12H). ..... S.australis

9. Carapace anteriorly produced into prominent shoulders over the eyes (Fig. 2.13A). Telson with 3 pairs of spines at base (Fig. 2.13B). ..... S.halei

--- Carapace without prominent shoulders over the eyes. Telson with 2 pairs of spines at base. 10

10. Telson with 2 pairs of stout spines at apex; inner pair shorter than outer pair (Fig. 2.13C). Proximal segment of exopod of uropod with 6-9 spines (Fig. 2.13D). Rostrum triangular completely covering base of eyestalks (Fig. 2.13E). .... S.quadrispinosa

--- Telson with one pair of stout spines at apex. Proximal segment of exopod of uropod with less than 9 spines. Rostrum not completely covering base of eyestalks. 11

11. Terminal lobe of antennal scale less than 2/3 as long as broad (Fig. 2.13F). Rostrum short in male, completely exposing eyestalks (Fig. 2.13G); produced in female, narrow, triangular and acutely pointed. ..... S.affinis

--- Terminal lobe of antennal scale more than 2/3 as long as broad. Rostrum triangular partially exposing eyestalks. 12

Fig. 2.13 Genus Siriella

A S.halei anterior of adult female x32.

B S.halei telson and uropod x39.
(Figs. A & B after W.M. Tattersall, 1927 Fig. 95a & c respectively).

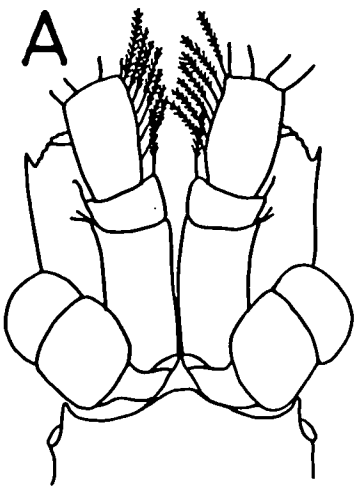
C S.quadrispinosa telson of adult female x45.

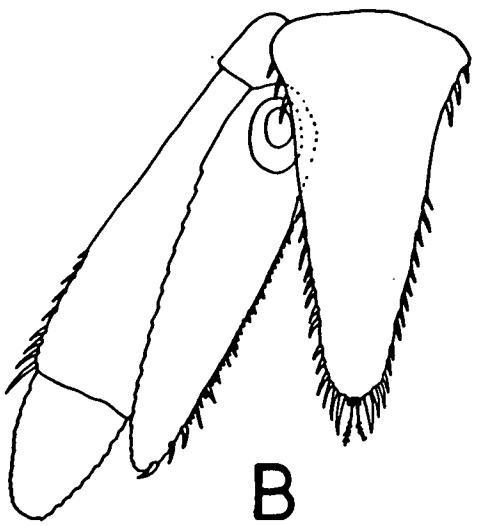
D S.quadrispinosa exopod of uropod x45.

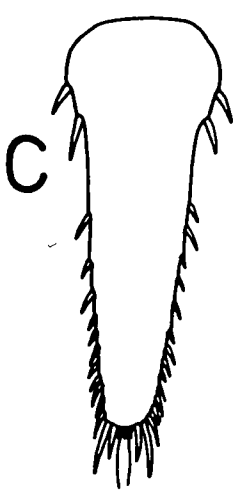
E S.quadrispinosa anterior of adult male x20.
(Figs. C, D & E after Ii, 1964 Fig. 22F, H & B respectively.

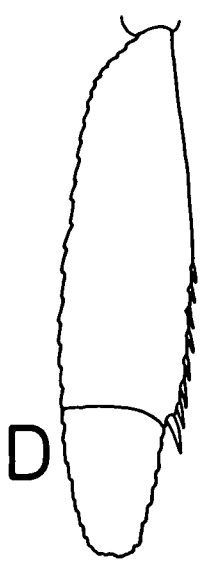
F S.affinis male antennal scale x39.

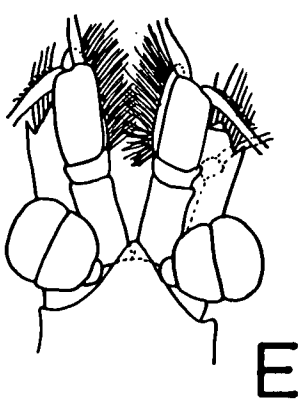
F S.affinis anterior of adult male x23.
(Figs. F & G after Hansen, 1910 Plate III, Figs. 3b & a respectively).

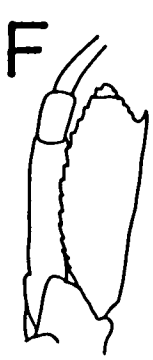

A

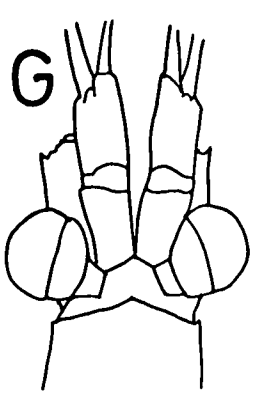

B


C


D


E


F


G

12. Carpo-propodus of thoracic endopods unsegmented (Fig. 2.14A). Antennal scale broad, distal articulation distinct in female but faint in male (Fig. 2.14B). Outer margin of exopod of uropod with 3-4 spines on proximal segment; endopod with spines along inner margin arranged in groups (Fig. 2.14C). ..... S.bacescui

--- Carpus and propodus distinct (Fig. 2.14D). Antennal scale somewhat narrow (Fig. 2.14E). Outer margin of proximal segment of exopod of uropod with 5-7 spines; endopod with spines arranged in groups along inner margin (Fig 2.14F). ..... S.vulgaris

13. Terminal setae of male pleopods 3 and 4 modified (Figs. 2.14G & H). Exopod of uropod with both spines and plumose setae on outer margin of proximal segment (Fig. 2.14I). ..... S.dubia

--- Terminal setae of both exopod and endopod of male pleopod 4 only modified. Exopod of uropod with spines on outer margin of proximal segment but no setae..... 14

14. Terminal setae of male pleopod 4 modified, nearly straight, one very long; penultimate segment of exopod with a single modified seta and 2 normal plumose setae (Figs. 2.15A & B); endopod with terminal seta pointed (Fig. 2.15C). ..... S.inornata

--- Terminal setae of male pleopod 4 modified, short and strongly curved; penultimate segment of exopod and endopod with 3 and 2 modified setae respectively (Figs. 2.15D & E). ..... S.media

15. Endopod of pleopod 3 and 4 with modified setae (Figs. 2.15F & G). Antennal scale with large terminal lobe (Fig. 2.15H). .... S.anomala

--- Endopod of pleopod 4 only with modified setae. Antennal scale with small terminal lobe (Fig. 2.15I). 16

16. Exopod of uropod longer than endopod. Endopod of pleopod 4 with 3 modified setae (Fig. 2.15J). ..... S.distinguenda

--- Exopod of uropod almost as long as endopod (Fig. 2.15K). Endopod of pleopod 4 with 4 modified setae (Fig. 2.15L). ... S.aequiremis

Siriella aequiremis Hansen, 1910

Diagnosis. Hansen, 1910; Ii, 1964.

Known Distribution. 37°N-10°S epipelagic (Mauchline and Murano, 1977); East

Fig. 2.14 Genus Siriella

A S.bacescui endopod of 6th thoracic leg.
(Scale 2.9mm drawn = 0.5mm).

B S.bacescui male antennal scale.

C S.bacescui uropod. (Scale of Fig. B & C 2.7mm drawn = 0.5mm).
(Figs. A, B & C after Udrescu, 1981 Fig. 1F, B & K, respectively).

D S.vulgaris third thoracic leg of female x37.

E S.vulgaris male antennal scale x37.

F S.vulgaris telson and uropod x37.
(Figs. D, E & F after Hansen, 1910 Plate III, Fig. 2f, b & h respectively).

G S.dubia terminal setae of male pleopod 3 exopod.

H S.dubia terminal setae of male pleopod 4 exopod.
(Figs. G & H after Pillai, 1973 Fig. 14H & J respectively, no scale provided).

I S.dubia exopod of uropod x50.
(Fig. I after Ii, 1964 Fig. 35M).

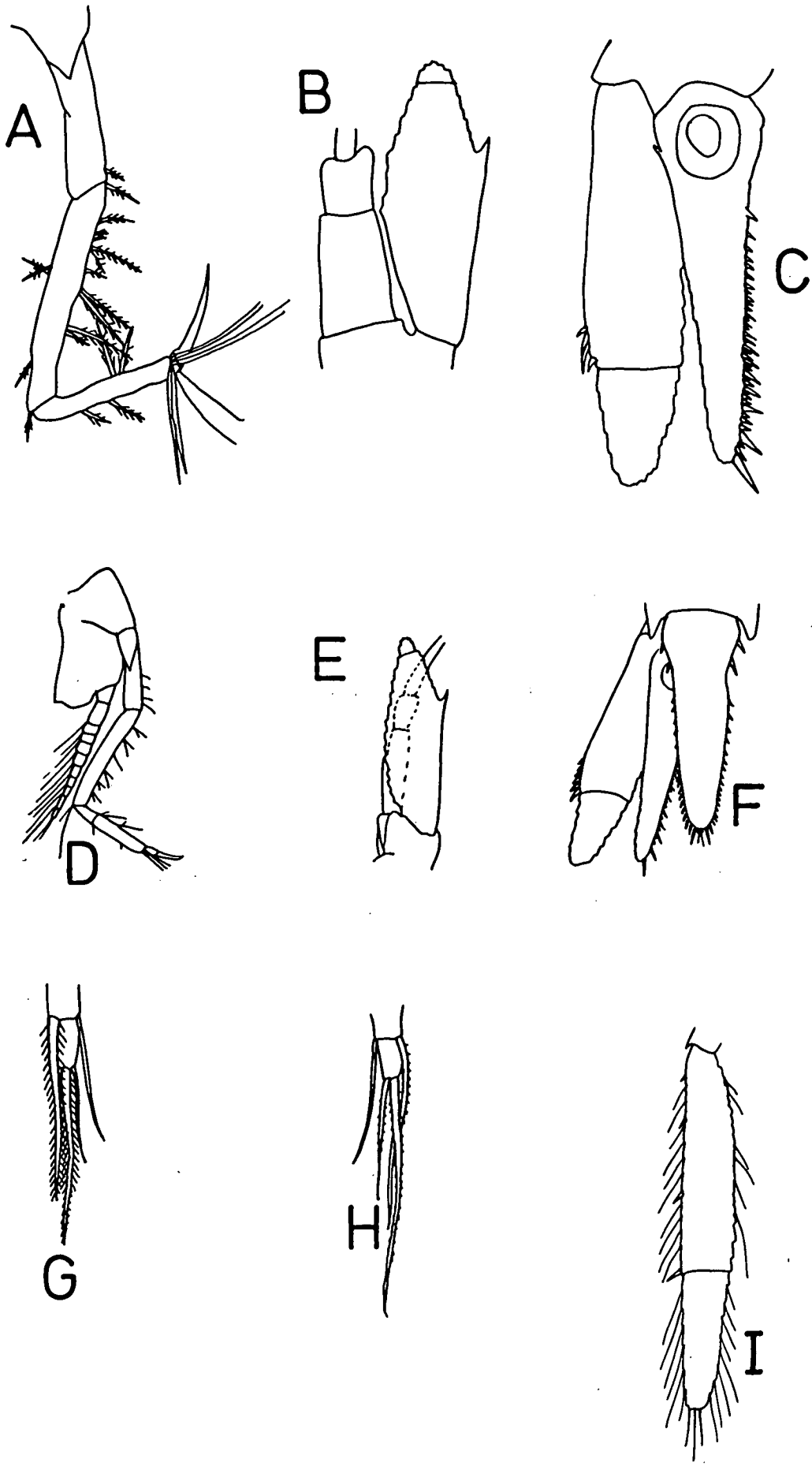

A
B
C
D
E
F
G
H
I

Fig. 2.15 Genus Siriella

A S.inornata distal part of exopod of pleopod 4; x84.

B S.inornata distal part of terminal spine of exopod of pleopod 4; x336.

C S.inornata distal part of endopod of pleopod 4; x 84.
(Figs. A, B & C after Hansen, 1910 Plate IV, Fig. 2g, h & f respectively).

D S.media distal part of exopod of pleopod 4; x100.

E S.media distal part of endopod of pleopod 4; x100.
(Figs. D & E after Hansen, 1910 Plate IV, Fig. 3f & e respectively).

F S.anomala distal part of exopod of pleopod 3; x92.

G S.anomala distal part of endopod of pleopod 4; x92.

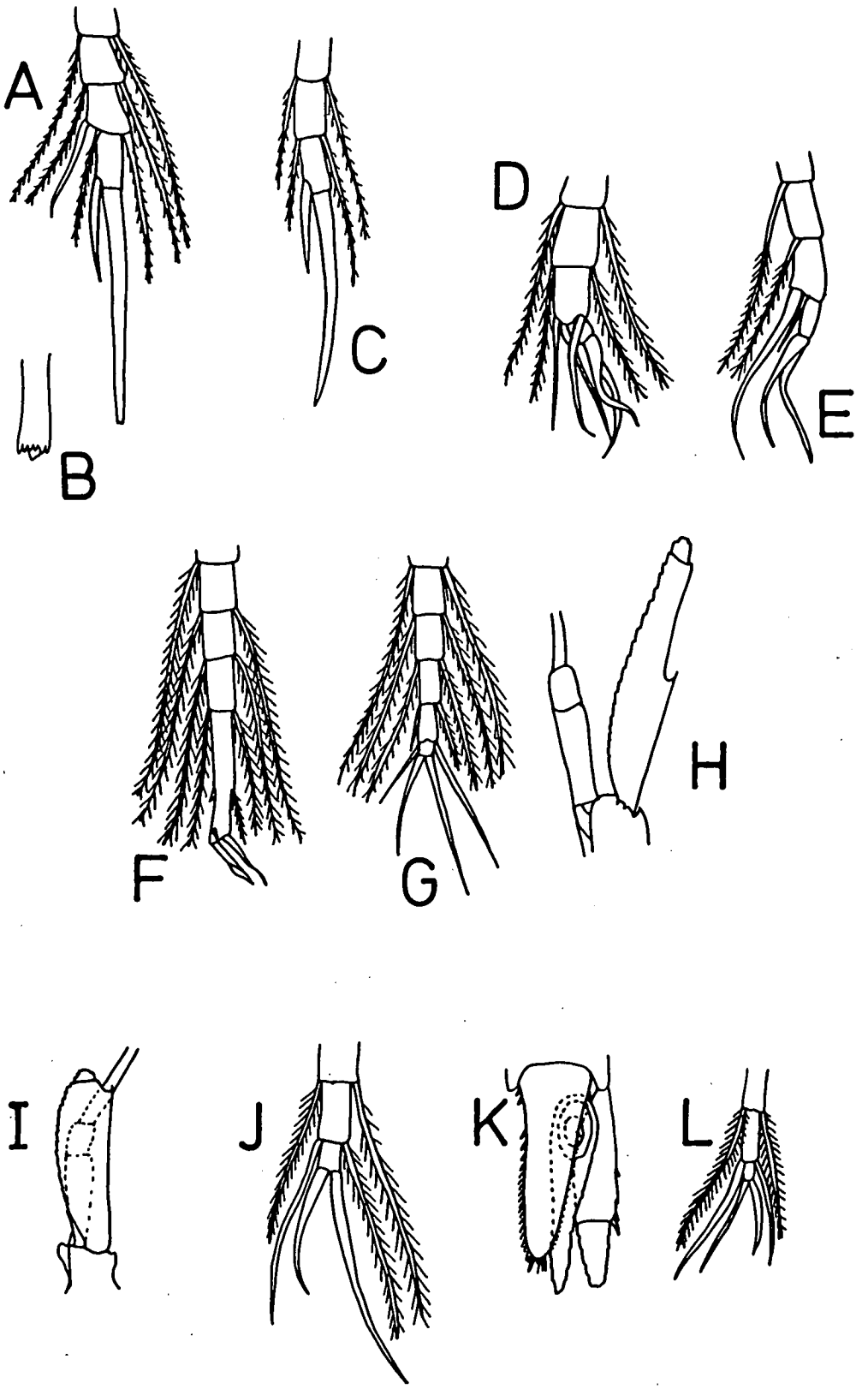
H S.anomala male antennal scale; x24.
(Figs. F, G & H after Hansen, 1910 Plate V, Fig. 1g, h & a respectively).

I S.distinguenda male antennal scale; x24.

J S.distinguenda distal part of endopod of pleopod 4; x124.
(Figs. I & J after Hansen, 1910 Plate V, Fig. 2a & c respectively).

K S.aequiremis telson and uropods, young female; x35.

L S.aequiremis distal part of endopod of 4th male pleopod.
(Figs. K & L after Ii, 1964 Fig. 37 J & B respectively).


A
B
C
D
E
F
G
H
I
J
K
L

Indies (Hansen, 1910); Red Sea (Coifmann, 1936); Philippine Islands (W.M. Tattersall, 1951); South China Sea (Ii, 1964); Indian Ocean (Pillai, 1973).

Australian Records.

1) Pillai (1973): West coast of Australia, Station 262 32°00'S 110°30'E, 1 female.

S.affinis Hansen, 1910

Diagnosis. Hansen, 1910; Ii, 1964.

Known Distribution. 20°N-5°N coastal (Mauchline and Murano, 1977); East Indies (Hansen, 1910); Carolina and Philippine Islands (W.M. Tattersall, 1951).

Australian Records.

1) Australian Museum Collection: Great Barrier Reef, Heron Island; 6 individuals.

S.anomala Hansen, 1910

Diagnosis. Ii, 1964.

Known Distribution. 20°N-20°S coastal (Mauchline and Murano, 1977); Paternoster Islands, Sunda Sea (Hansen, 1910); Marshall, Carolina and Philippine Islands (W.M. Tattersall, 1951); Iwayama Bay, Korror Island, Palau Island (Ii, 1964).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, Low Isle Anchorage, 28-6-1929, small coarse net at night; 1 male.

S.australis W.M. Tattersall, 1927

Diagnosis. W.M. Tattersall, 1927.

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1927): South Australia, Gulf of St. Vincent.
2) W.M. Tattersall (1940): New South Wales, Port Stephens, June 1938, numerous individuals; Port Hacking. South Australia, Kangaroo Island.
3) Dakin and Colefax (1940): New South Wales, Broken Bay, night sample.
4) South Australian Museum Collection: represented in 11 samples, all collected near Pt. Pirie at mouth of creeks in 0.4-4.8m depth, over Posidonia sp.and Amphibolus sp..
5) National Museum of Victoria Bass Strait Survey: Stations: 108,109,117, 126, 154, 166, 177, 181 and 184.
6) Tasmania: Middleton.

S.bacescui Udrescu, 1981

Diagnosis. Udrescu, 1981.

Known Distribution. Australia.

Australian Records.

1) Udrescu, (1981): Great Barrier Reef, Benett Island, Chesterfield group.

S.distinguenda Hansen, 1910

Diagnosis. Hansen, 1910; Ii, 1964.

Known Distribution. 20°N-10°S coastal (Mauchline and Murano, 1977); East Indies (Hansen, 1910); Philippine Islands (W.M. Tattersall, 1951).

Australian Records.

1) Bacescu (1979): Great Barrier Reef, Heron Island; numerous individuals in surface night plankton.
2) Australian Museum Collection: Great Barrier Reef, Heron Island; 6 individuals, no mature male; thus identification was not positive.

S.dubia Hansen, 1910

Diagnosis. Ii, 1964; Pillai, 1964 & 1973.

Known Distribution. 20°N-20°S littoral (Mauchline and Murano, 1977); East Indies (Hansen, 1910); India (W.M. Tattersall, 1922); Philippine Islands (W.M. Tattersall, 1951); South China Sea (Ii, 1964).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, east of Low Isles; 25 individuals.

S.gracilis Dana, 1852

Diagnosis. Ii, 1964.

Known Distribution. 38°N-30°S epipelagic (Mauchline and Murano, 1977); widely distributed in the tropical and subtropical waters of the Indian and Pacific Oceans (W.M. Tattersall, 1951). This species usually occurs with S.thompsonii (Ii, 1964).

Australian Records.

1) Pillai (1973): West coast of Australia at Stations 204, 208, 220, 240, 362 and 381.

S.halei W.M. Tattersall, 1927

Diagnosis. W.M. Tattersall, 1927.

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1927): South Australia, Gulf of St. Vincent.

2) South Australian Museum Collection: represented in 6 samples, all collected near Pt. Pirie.
3) National Museum of Victoria Bass Strait Survey: Station 178

S.inornata Hansen, 1910

Diagnosis. Hansen, 1910.
Known Distribution. 20°N-20°S coastal; East Indies (Hansen, 1910); Philippine Islands (W.M. Tattersall, 1951).
Australian Records.
1) W.M. Tattersall (1936a): Dredged in Owen Channel, Flinders Island, Princess Charlotte Bay, North Queensland.
2) W.M. Tattersall (1936a): Great Barrier Reef, Low Isles Anchorage and Low Isles Flat; 23 Specimens.
3) Australian Museum Collection: Great Barrier Reef, Heron Island; 5 individuals.

S.longidactyla W.M. Tattersall, 1940

Diagnosis. W.M. Tattersall, 1940.
Known Distribution. Australia.
Australian Records.
1) W.M. Tattersall (1940): New South Wales, Port Stephens.
2) Dakin and Colefax (1940): New South Wales, Port Stephens, estuary.

S.media Hansen, 1910

Diagnosis. Ii, 1964.
Known Distribution. 35°N-10°S coastal (Mauchline and Murano, 1977); East Indies (Hansen, 1910); Gilbert Islands-lagoon (Hansen, 1912); Philippine Islands (W.M. Tattersall, 1951); Nagatsuro, Kamo District and Shizuoka Prefecture (Ii, 1964).
Australian Records.
1) Australian Museum Collection: Great Barrier Reef, Heron Island; 6 individuals.

S.nodosa Hansen, 1910

Diagnosis. Hansen, 1910; Ii, 1964.
Known Distribution. 10°N-18°S coastal; East Indies (Hansen, 1910); Torres Strait (Colosi, 1919 & 1920).
Australian Records.
1) W.M. Tattersall (1936a): Great Barrier Reef, Low Isles Anchorage.
2) Bacescu (1979): Great Barrier Reef, Heron Island, widespread.

3) Australian Museum Collection: Great Barrier Reef, Heron Island; 5 individuals.

S.quadrispinosa Hansen, 1910

Diagnosis. Hansen, 1910; Ii, 1964.

Known Distribution. 35°N-0°S coastal (Mauchline and Murano, 1977); East Indies (Hansen, 1910); Gulf of Manaar, India (W.M. Tattersall, 1922); Koniya Bay, Amami-Oshima, Liu-kiu (Luchu) Islands, Nagatsuro Kamo District and Schizuoka Prefecture (Ii, 1964).

Australian Records.

1) Australian Museum Collection: Great Barrier Reef, Heron Island, 5 individuals.
2) Bacescu (1979): Great Barrier Reef.

S.thompsonii (Milne-Edwards, 1837)

Diagnosis. Ii, 1964; Pillai, 1973.

Known Distribution. 42°N-40°S epipelagic (Mauchline and Murano, 1977); Hawaiian Islands (Ortmann, 1905; Hansen, 1912); Tropical Pacific (W.M. Tattersall, 1923); Atlantic and Indian Oceans (Illig,1930); Red Sea (Coifmann,1937); North Pacific (Sars, 1885); Japan (Ii, 1964).

Australian Records.

1) Sars (1885): Between Sydney and New Zealand.
2) W.M. Tattersall (1936a): Great Barrier Reef, East of Low Isles; 1 immature male.
3) Pillai (1973): West coast of Australia at Stations 208, 221, 223, 236, 251, 257, 380 and 790.
4) McWilliam and Phillips (1983): South-east Australian coast; Eddy J.

S.vincenti W.M. Tattersall, 1927

Diagnosis. W.M. Tattersall, 1927.

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1927): South Australia, Gulf of St. Vincent.
2) Dakin and Colefax (1940): New South Wales, unspecified locality.
3) National Museum of Victoria Bass Strait Survey: Stations: 112, 113, 114, 115, 116, 117, 156, 158, 177, 192, 197, 202, 212 and Ransonnet Bay.
4) Australian Museum Collection: Great Barrier Reef, Lizard Island lagoon; 1 juvenile, damaged.
5) Tasmania: Margate Beach, North-West Bay; Darlington, Maria Island.

S.vulgaris Hansen, 1910

Diagnosis. Ii, 1964.

Known Distribution. 12°N-20°S epipelagic (Mauchline and Murano, 1977); East Indies (Hansen, 1910); India (W.M. Tattersall, 1922); Arabian Sea (Colosi, 1924); Hong Kong and Peru (Coifmann, 1937); Philippine Islands, Taiwan (W.M. Tattersall, 1951).

Australian Records.

1) W.M. Tattersall (1928): Owen Channel, Flinders Island, Princess Charlotte Bay, North Queensland, 2 immature females, consequently only recorded provisionally under this name.
2) W.M. Tattersall (1936a): Great Barrier Reef, east of Low Isles 1 juvenile; Low Isles Anchorage and Low Isles Flat; 20 individuals including adult males, females and juveniles.

2.3.2.2.3 Sub-family RHOPALOPHTHALMINAE

Definition. Labrum broader than long, without frontal spine. Propodus of thoracic limbs divided by transverse articulations into several sub-segments; dactylus rudimentary. Female brood pouch formed by 3 pairs of lamellae. Male pleopods well-developed, biramous; 4 posterior pairs with lamellar pseudobranchiae. Both exopod and endopod of uropods divided into 2 segments; outer margin of exopod without spines, only setae (Ii, 1964).

Remarks. Only one genus, Rhopalophthalmus, is known in this sub-family.

i) Genus Rhopalophthalmus Illig, 1906

Diagnosis. Carapace short leaving eyes uncovered anteriorly and last 3 thoracic segments exposed posteriorly. Posterior to each eye a strong spine is present, a well-developed keel extends backwards from these spines to cervical sulcus. Short triangular rostral plate present between post-orbital spines and antero-lateral angles (cheeks). Delicate epimeral plates present on either side of first abdominal segment in male only. Antennal scale long and narrow; outer margin naked, terminating in a strong spine which extends beyond scale apex; small distal segment. Endopod of thoracic limbs 3-7 with distinct carpus; propodus composed of sub-segments. Endopod of eighth thoracic leg rudimentary, composed of 1-3 segments; exhibits marked sexual dimorphism. Telson linguiform, entire; lateral margins unarmed proximally, distally with 7-16 spines extending to apex. Apex armed with 2 pairs of long, strong spines arising on ventral surface behind statocyst (Ii, 1964).

Endopod of uropod with single strong spine

Remarks. Fifteen species have been described (Mauchline, 1980). Of these, two only are known from Australia.

Key to the Australian Species of Rhopalophthalmus

1. Anterior margin of carapace straight; "cheeks" sinuous (Figs. 2.16A & B). Antennal sympod with 13 small spines on inner angle (Fig. 2.16C). Propodus of 4th to 7th thoracic endopods with 4-6 segments; endopod of eighth thoracic leg in male short 3-segmented in female 2 segmented. ..... R.dakini

--- Anterior margin of carapace slightly convex; "cheeks" sinuous (Fig. 2.16D). Antennal sympod with 4 spines on inner angle (Fig. 2.16E). Endopod of eighth thoracic leg in male composed of 2 segments and 1 segment in female. ..... R.brisbanensis

Rhopalophthalmus brisbanensis Hodge, 1963a

Diagnosis. Hodge, 1963a.

Known Distribution. Australia.

Australian Records.

1) Hodge (1963a): Brisbane River, Queensland.
2) Bacescu (1983): Great Barrier Reef, Heron Island.

R.dakini O.S. Tattersall, 1957

Diagnosis. O.S. Tattersall, 1957.

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1940): New South Wales, Lake Illawarra recorded originally as R.egregius, later separated as a distinct species by O.S. Tattersall, 1957.
2) W.M. Tattersall (1936a): Great Barrier Reef, Trinity Opening; 1 juvenile only.

2.3.2.2.4 Sub-family GASTROSACCINAE

Definition. Labrum much longer than broad bearing a long frontal process. Thoracic legs 3-8 with either distinct carpus and sub-divided propodus or both segments fused forming a carpo-propodus which is sub-divided. Exopod of 3rd male pleopod elongate; form of other male pleopods including endopod of 3rd pleopod varies. Female brood pouch formed by 2 pairs of brood lamellae together with pleural plates from the first abdominal segment. Telson with apical cleft. Both exopod and endopod of uropods undivided. Outer margin of exopod with spines but no setae (Tattersall and Tattersall, 1951; Ii, 1964).

Fig. 2.16 Genus Rhopalophthalmus

A Rhopalophthalmus dakini anterior end of carapace (flattened out) x35.

B R.dakini anterior end of carapace in lateral view x35.

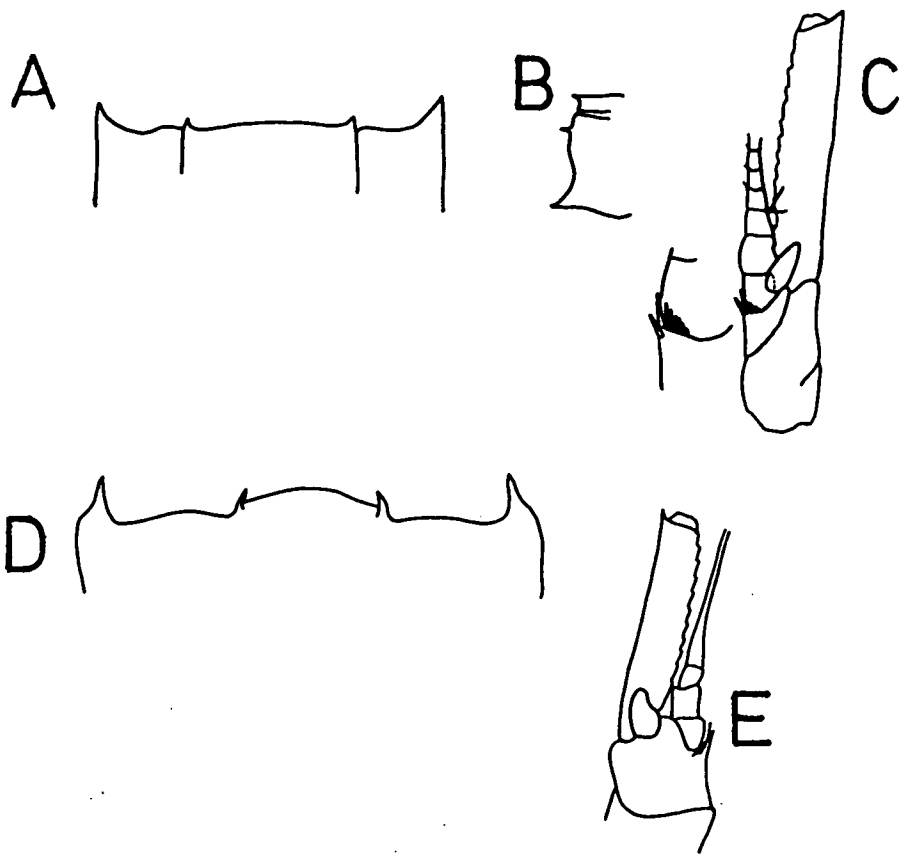
C R.dakini Antenna x25; note inner distal angle of antennal sympod.

(Figs. A, B & C after O.S. Tattersall, 1957 Fig. 3A, B, C & D respectively).

D R.brisbanensis anterior margin of carapace.

E R.brisbanensis antenna. (Scale for Fig. D & E 1.2cm = 0.5mm).

(Figs. D & E after Hodge, 1963a Figs. 1a & 2c respectively).


A
B
C
D
E

Remarks. Eight genera are known to belong to this sub-family (Mauchline, 1980). Of these five are represented in Australian waters.

i) Genus Anchialina Norman and Scott, 1906

Diagnosis. Body compact and robust. Carapace large, commonly covering entire thorax and part of 1st abdominal segment; posterior margin straight and transverse. Rostrum usually prominent. Eyes large with thick short eyestalks. Antennal scale broad; small distal segment; outer margin naked terminating in a small spine. First thoracic limb with very strong thick claw. Second thoracic limb with 5th segment of endopod simple in female, expanded and produced posteriorly in male. Thoracic legs 3-8 with large basal segment; propodus sub-divided by transverse articulations. Female with 2 pairs of brood lamellae. Pleopods of female rudimentary; first pair rod-like; pairs 2-5 modified, broad almost rectangular in shape covering anterior half of succeeding somite. Pleopods of male well-developed; first pair uniramous; pairs 2-5 biramous, multi-articulate. Exopod of 3rd pleopod elongated with modified setae. Pseudobranchiae well-developed, broad and lamellar. Endopod of uropods armed with a dense row of spines along inner border. Exopod slightly shorter than endopod; outer margin armed with small spines and no setae (Tattersall and Tattersall, 1951; Ii, 1964).
Remarks. Fifteen species are known in the genus (Mauchline, 1980); of these five have been recorded from Australian waters.

Key to the Australian Species of Anchialina

1. Rostrum short and obtuse (Fig. 2.17A). ..... A.typica
--- Rostrum long and triangular. 2

2. Exopod of third male pleopod without lobose process among terminal setae (Fig. 2.17B). Fifth segment of second thoracic endopod with concave region irregularly toothed (Fig. 2.17C). Body conspicuously spiny (Fig. 2.17D). ..... A.dentata
--- Exopod of third male pleopod with lobose process among terminal setae. Second thoracic leg not as above. Body smooth. 3

3. Inner margin of male antennular peduncle not densely setose (Fig. 2.17E). ..... A.grossa
--- Inner margin of male antennular peduncle densely setose. 4

Fig. 2.17 Genus Anchialina

A Anchialina typica anterior of male x35.
(After Ii, 1964 Fig. 48E).

B A.dentata terminal setae of third male pleopod.

C A.dentata endopod of second thoracic leg.

D A. dentata anterior of male.
(Figs. B, C & D after Pillai, 1973 Figs. 34G, C and 33A respectively).

E A.grossa anterior of adult male x20.
(After Hansen, 1910 Plate VII, Fig. 3a).

F A.zimmeri antennular peduncle and eye x39.

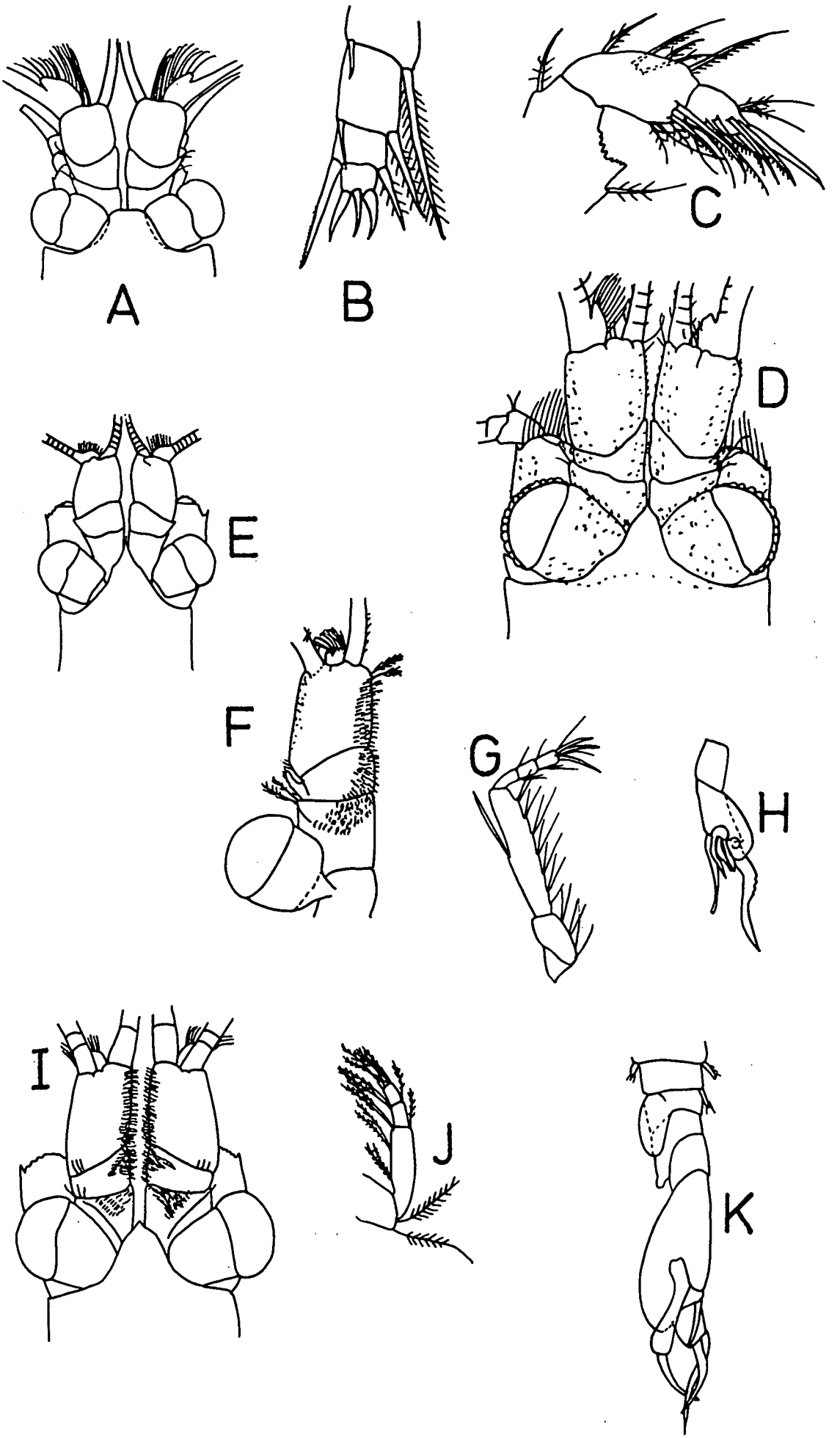
G A.zimmeri distal part of endopod of third thoracic limb x39.

H A.zimmeri distal part of exopod of third male pleopod.
(Figs. F, G & H after W.M. Tattersall, 1951 Fig. 31A, E & G respectively).

I A.penicillata anterior of male x34.

J A.penicillata distal part of endopod of third thoracic limb x57.

K A.penicillata exopod of third male pleopod x155.
(Figs. I, J & K after Zimmer, 1915 Figs. 7, 10 & 11 respectively).


A
B
C
D
E
F
G
H
I
J
K

4. Presence of minute spinules on outer margin of distal segment of antennular peduncle (Fig. 2.17F). Carpus and two propodus segments sub-equal in length (Fig. 2.17G). Terminal setae of third male pleopod of form in Fig. 2.17H. ..... A.zimmeri

--- No spinules on outer margin of distal segment of antennular peduncle (Fig. 2.17I). Carpus longer than combined length of 2 propodus segments (Fig. 2.17J). Terminal setae of third male pleopod of form in Fig. 2.17K. ..... A.penicillata

Anchialina dentata Pillai, 1964

Diagnosis. Pillai, 1964, 1973.

Known Distribution. 20°N-6°S (Mauchline and Murano, 1977); Indian Ocean (Pillai, 1964 and 1973); South China Sea, west coast of Borneo, Java Sea and Gulf of Tonking (Ii, 1964).

Australian Records.

1) Pillai (1973): West coast of Australia, Station 225; 1 male.

A.grossa Hansen, 1910

Diagnosis. Hansen, 1910.

Known Distribution. 20°N-20°S coastal (Mauchline and Murano, 1977); East Indies, Bay of Bengal, Gulf of Siam, South China Sea (Hansen, 1910); Gilbert Islands (Hansen, 1912); between Ceylon and New Guinea (Zimmer, 1915); Port Blair, Andaman Island, India (W.M. Tattersall, 1922); Philippine Islands (W.M. Tattersall, 1951).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, Low Isles Anchorage and east of Low Isles, 2 individuals both immature females.
2) Australian Museum Collection: Great Barrier Reef, Heron Island and Lizard Island; juvenile, female, immature female and damaged individuals.

A.penicillata Zimmer, 1915

Diagnosis. Zimmer, 1915.

Known Distribution. 20°N-32°S coastal (Mauchline and Murano, 1977); between Ceylon and Dampier Strait (Zimmer,1915); Marshall Islands and Philippine Islands (W.M. Tattersall, 1951).

Australian Records.

1) W.M. Tattersall (1940): New South Wales, Port Stephens; 5 male and 1 female.

A.typica (Kroyer, 1861)

Diagnosis. O.S. Tattersall, 1955; Pillai, 1973; Ii, 1964.

Known Distribution. 35°N-35°S off-shore (Mauchline and Murano, 1977); Tropical Atlantic (Kroyer, 1861); Hawaiian Islands (Ortmann, 1905); West Indies, Gulf of Siam, East Indies (Hansen, 1910); Gilbert Islands (Hansen, 1912); Caribbean Sea (Colosi, 1919 & 1920); Andaman Islands and Gulf of Manaar (W.M. Tattersall, 1922); off Rio de Janeiro (W.M. Tattersall, 1923); Western Atlantic near Bermuda and Bahama (W.M. Tattersall, 1922 & 1936b); Philippine Islands (W.M. Tattersall, 1951); Mid-Atlantic and Benguela Current (O.S. Tattersall, 1955).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, Barrier Reef Lagoon east of Low Isles; occurred in small numbers.
2) Pillai (1973): West coast of Australia, Station 207.

A.zimmeri W.M. Tattersall, 1951

Diagnosis. W.M. Tattersall, 1951.

Known Distribution. 20°N-10°N (Mauchline and Murano, 1977); Philippine Islands from Sablayan Bay Anchorage and Minanao Strait (W.M. Tattersall, 1951).

Australian Records.

1) Bacescu (1979): Great Barrier Reef, in plankton at Heron Island. NB. Bacescu incorrectly states that this species was reported by Tattersall (1927); it was in fact A.penicillata reported by Tattersall and it was in 1940. A.zimmeri was only described in 1951. Consequently, the first record of this species from Australia and outside of the Philippine Islands appears in Bacescu (1979).

ii) **Genus Gastrosaccus** Norman, 1868

Diagnosis. General body form slender, slightly laterally compressed. Rostral plate usually small, triangular and obtuse. Posterior margin of carapace deeply emarginate dorsally exposing last thoracic segment; posterior dorsal margin either entire, or with reflexed lobes, or with a fringe of filaments. Eyes small, cylindrical. Antennal scale short; outer margin naked, with strong terminal spine. Labrum with forwardly directed long median spine; small spines sometimes arm lateral borders of median spine. Thoracic endopods 3-8 with fused carpo-propodus divided into numerous short sub-segments, 5-7 in anterior pairs and increasing to 10-13 in posterior pairs. Expanded pleural plates from first abdominal segment of female,

together with 2 pairs of brood lamellae form the brood pouch. First pair of female pleopods biramous, pairs 2-5 rudimentary and uniramous. Male pleopods usually biramous. Endopod of pleopods 1, 4 and 5 rudimentary, unsegmented; endopod of pleopod 2 usually long and segmented sometimes with modified setae, occasionally endopod unsegmented. Endopod of pleopod 3 sometimes long and segmented, or unsegmented distinct from or fused with protopod, or totally absent (see Haplostylus). Exopod of pleopod 1 and 2 long and segmented; exopod of pleopod 3 markedly elongate; exopod of pleopod 4 and 5 long and segmented or short and segmented or sometimes rudimentary and minute. Telson with apical cleft; both cleft and lateral margins armed with spines. Uropods; outer margin of exopod armed with long stout spines but no setae; inner margin of endopod armed with a few long spines (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. This genus is complex, many authors have suggested splitting it into several genera. This has been carried out to some extent in recent years by Bacescu (1968b) with the formation of the genera Bowmaniella and Iiella, and in 1973 also by Bacescu, with the resurrection of the genus Haplostylus. However, further revision is still necessary (see Haplostylus remarks).

Only one species, G.daviei, from the 8 Australian species in the genera Gastrosaccus/Haplostylus appears to be a true Gastrosaccus species. A combined key for Gastrosaccus and Haplostylus is provided due to the unclear status of the latter genus.

Key to the Australian Species of Gastrosaccus and Haplostylus

1. Endopod of third male pleopod segmented (Fig. 2.18A). Telson with 12-15 spines arming lateral borders (Fig. 2.18B). .... G.daviei

--- Endopod of third male pleopod unsegmented. Telson with 12 or fewer spines arming lateral borders. 2

2. Spinous process on the fifth abdominal segment (Fig. 2.18C). 3

--- Spinous process absent. 4

3. Exopod of male pleopod 4 composed of 8 segments; pleopod 5 short and unsegmented (Fig. 2.18C). Lateral margins of telson with 8-9 spines (Fig. 2.18D). Endopod of uropod with 6 spines on inner margin, outer margin of exopod with 13-18 spines (Fig. 2.18E).

Fig. 2.18 Genera Gastrosaccus and Haplostylus

A Gastrosaccus daviei male pleopod 3.

B G.daviei male telson.
(Figs. A & B, scale 2.3cm = 0.5mm).
(Figs. A & B after Bacescu and Udrescu, 1982 Fig. 1I & P).

C H.(G.)brisbanensis 5th male pleopod and 5th abdominal segment with spinous process. (Scale 1.2cm = 0.5mm).

D H.(G.)brisbanensis male telson.

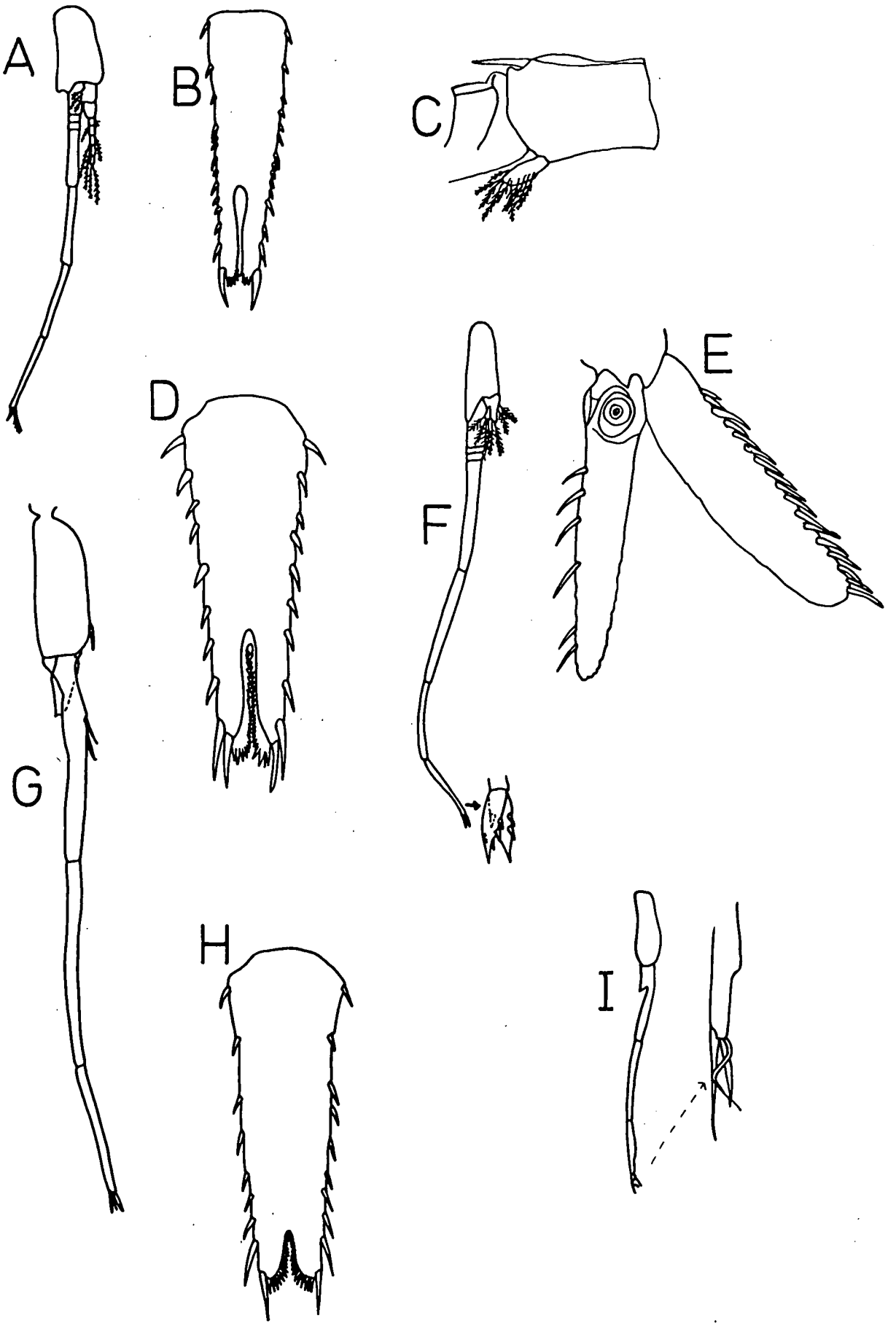
E H.(G.)brisbanensis male uropod.

F H.(G.)brisbanensis third male pleopod.
(Figs. G, H & I scale 4.3cm = 1.0mm).
(Figs. G, H & I after Bacescu and Udrescu, 1982 Fig. 2C, H, M & D respectively).

G H.(G.)indicus third male pleopod x42.

H H.(G.)indicus telson x49.
(Figs. J & K after W.M. Tattersall, 1940 Fig. 2f & b respectively).

I H.(G.)pacificus third male pleopod x33, terminal setae x100.
(After W.M. Tattersall, 1922 Fig. 8a & b).


A
B
C
D
E
F
G
H
I

Terminal setae of male pleopod 3 broad and with denticles (Fig. 2.18F). ..... H.(G.)brisbanensis

--- Exopod of male pleopods 4 and 5 segmented (Figs. 2.20H & I). Lateral margins of telson armed with 5 spines (Fig. 2.21B). Endopod of uropod with 8 spines on inner margin, outer margin of exopod with 12 spines (Fig. 2.21C). Male pleopod 3 with 1 barbed and 2 simple terminal setae (Fig. 2.21A). ..... H.sp.1 n.sp.

4. Exopod of male pleopods 4 and 5 short and unsegmented. 5

--- Exopod of male pleopods 4 and 5 multi-segmented. 6

5. Endopod of 2nd male pleopod unsegmented. Exopod of third male pleopod composed of 4 segments terminating in 2 small simple setae (Fig. 2.18G). Lateral margins of telson with 10 spines (Fig. 2.18H). ..... H.(G.)indicus

--- Endopod of 2nd male pleopod composed of 2 segments. Exopod of 3rd male pleopod composed of 3 segments terminating in 2 spines and a sinuous lash-like seta (Fig. 2.18I). Lateral margins of telson with 12 spines, penultimate spine much longer than apical ones. ..... H.(G.)pacificus

6. Lateral margins of telson armed with 11-13 spines (Fig. 2.19A). Exopod of 3rd male pleopod composed of 5 segments (Figs. 2.19B & C). Rami of 2nd male pleopod specially modified with a process and strong seta (Fig. 2.19D). .... H.(G.)bengalensis

--- Lateral margins of telson armed with 6-7 spines. Exopod of 3rd male pleopod composed of 3 or 4 segments. Terminal setae of 2nd male pleopod not as above. 7

7. Exopod of 3rd male pleopod composed of 3 segments (Figs. 2.19E & F). Endopod of 2nd male pleopod composed of 6 segments; terminal setae simple and curved (Fig. 2.19G). Lateral edges of telson armed with 6 spines. ..... H.(G.)dakini

--- Exopod of 3rd male pleopod composed of 4 segments (Fig. 2.19I & J). Endopod of 2nd male pleopod composed of 7 segments; terminal setae modified (Fig. 2.19K). Lateral margins of telson with 7 spines (Fig. 2.19L). ..... H.(G.)queenslandensis

Fig. 2.19 Genera Gastrosaccus and Haplostylus

A H.(G.)bengalensis telson x50.

B H.(G.)bengalensis third male pleopod x50.

C H.(G.)bengalensis terminal armature of exopod of third male pleopod x200.

D H.(G.)bengalensis second male pleopod.

(Figs. A, B, C & D after Ii, 1964 Fig. 68I, E, F & D respectively).

E H.(G.)dakini third male pleopod x42.

F H.(G.)dakini distal end of third male pleopod x127.

G H.(G.)dakini second male pleopod x73.

H H.(G.)dakini telson x49.

(Figs. E, F, G & H after W.M. Tattersall, 1940 Fig. 4c, d, b & 3c respectively).

I H.(G.)queenslandensis third male pleopod.

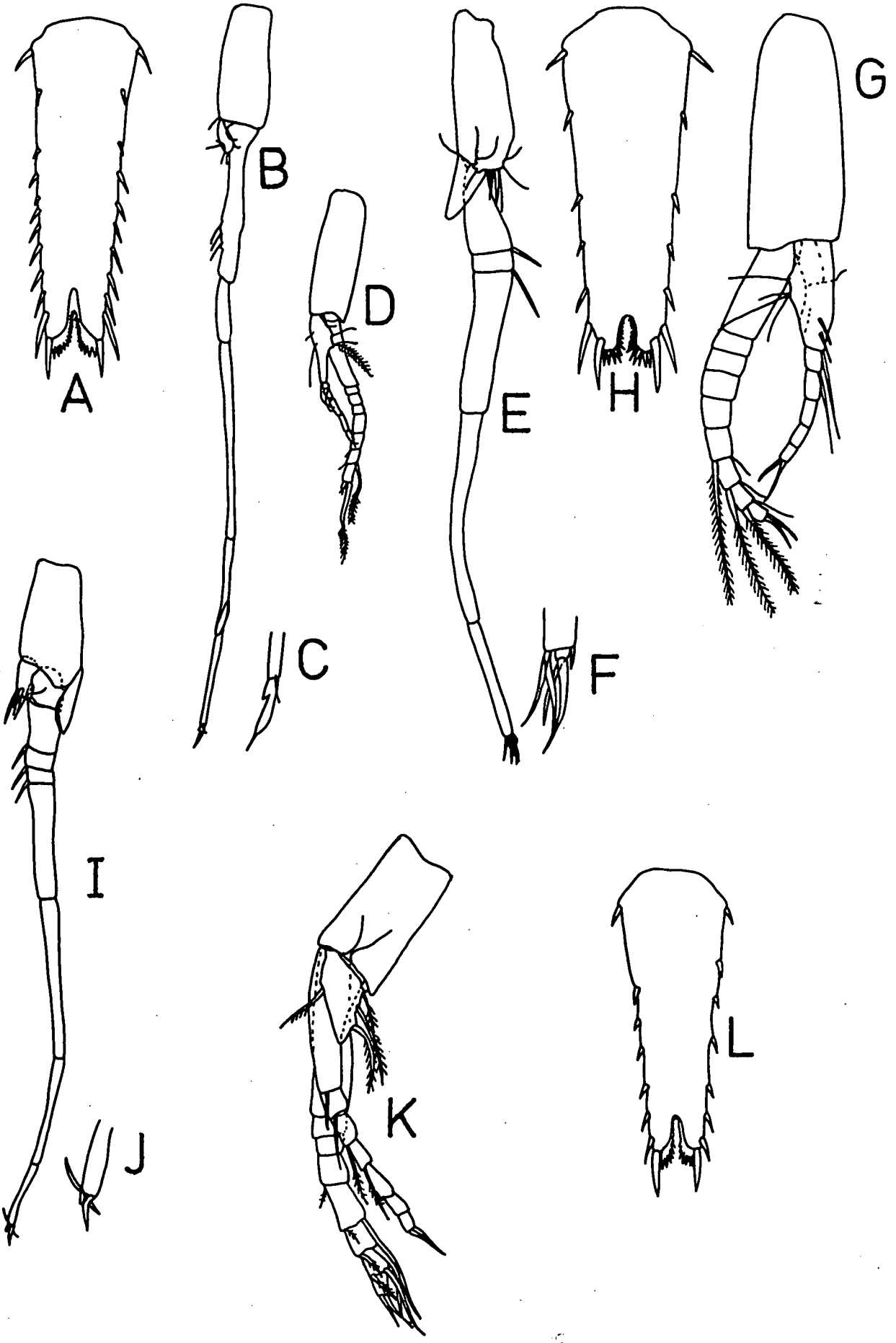
J H.(G.)queenslandensis distal end of third male pleopod.

K H.(G.)queenslandensis second male pleopod.

L H.(G.)queenslandensis male telson.

(Figs. I & L scale 2.5cm = 0.5mm; Figs. J & K scale 3.0cm = 0.3mm).

(Figs. I, J, K & L after Bacescu and Udrescu, 1982 Fig. 3 K, k, J & M respectively).


A
B
C
D
E
F
G
H
I
J
K
L

Gastrosaccus daviei Bacescu and Udrescu, 1982

Diagnosis. Bacescu and Udrescu, 1982.

Known Distribution. Australia.

Australian Records.

1) Bacescu and Udrescu (1982): Queensland, Moreton Bay at Middle banks and Bramble Bay.

iii) Genus Haplostylus Bacescu, 1973b

Diagnosis. Bacescu (1973b; p.321) "Gastrosaccini with male pleopods well-developed, pairs I, II and V with unisegmented endopodite, exopodite of pleopod III with a minute endopodite and the four long segments reaching the end of the abdomen. Two or three articulation girdles divided the thick basal segment in 2-5 short segments. Without any supplemental segment on the dorsal portion of the junction between the last two pleonites."

Remarks. Kossmann (1880) established the genus Haplostylus to accept those species in the sub-family Gastrosaccinae which lacked lobes on the posterior margin of the carapace. However, this was later found to be a poor character to distinguish Haplostylus from its closely allied genus Gastrosaccus (Tattersall and Tattersall, 1951), and all the species involved were placed in the genus Gastrosaccus and the genus Haplostylus abandoned. The genus Gastrosaccus, however, clearly held species with a mixture of generic belongings as evidenced by the 2 major divisions it contained, i.e. the so-called "spinifer" and "normani" groups, depending on whether the endopod of the third male pleopod was multi-articulate or unsegmented respectively.

Bacescu (1973b) reinstated the generic name Haplostylus to accept those species in which the endopod of the third male pleopod was unsegmented. The revival of the genus was a result of a new species H.estafricana being described by Bacescu in 1973 from eastern African waters. At this time he also referred Kossmann's original species, H.erythraeus, and also H.parerythraeus and H.(G.)pusillus, to the genus Haplostylus. Hatzakis (1977) followed up what Bacescu had started by suggesting the transfer of the following species to the genus Haplostylus: H.(G.)normani, H.(G.)lobatus, H.(G.)magnilobatus, H.(G.)pacificus, H.(G.)indicus and H.(G.)dakini, together with describing a new species, H.bacescui. In addition, according to Hatzakis (1977), G.vulgaris, G.philippinensis (which had been synonymised with G.bengalensis by W.M. Tattersall in 1951) and G.johnsoni (which had been transferred to the genus Bowmaniella by Bacescu in 1968b) would be transferred to the genus

Haplostylus when more detailed descriptions became available. Clearly, Hatzakis (1977) was confused with the current status of the latter two species. However, H.(G.)bengalensis together with two species described by Bacescu and Udrescu (1982), H.(G.)brisbanensis and H.(G.)queenslandensis, should also be transferred to the genus Haplostylus on the basis of the structure of the third male pleopod. The status of G.vulgaris Nakazawa, 1910 remains unclear due to an inadequate original description. Ii (1964) discussed the possibility that it may be synonymous with the relatively common Japanese species Archaeomysis kokuboi since he was unable to collect any specimens of G.vulgaris despite repeated attempts near the type locality.

Examining the Haplostylus species in relation to the genus diagnosis, (Table 2.3) it can be seen that both the endopod and exopod of male pleopod 2 are segmented in the majority of the species including H.erythraeus (Kossmann's original species). Presumably this is true of H.bacescui also since Hatzakis (1977) refers to the pleopods "as in H.normani", in which pleopod 2 has a segmented endopod. It may be that Bacescu (1973b) meant unsegmented endopod on pleopods 1, 3, 4 and 5 rather than 1, 2 and 5 as stated. The presence of an apophysis on the dorsal surface of the 5th abdominal segment occurs in two species, H.(G.)brisbanensis and H.sp.1 n.sp. This feature would, according to the generic diagnosis, remove these species from the genus Haplostylus; it is a feature that occurs in some but not all of the species in the genus Gastrosaccus. However, it appears that the only consistent feature among the species of Haplostylus is the structure of the third male pleopod. This feature alone is considered by Bacescu (1973b; p.321) as "a good feature for a generic taxon, the structure of this pleopod representing for the generic division of mysids, the same value as the genital armature does in insects."

Until a complete revision of the two genera Haplostylus and Gastrosaccus is conducted, the separation of genera on the basis of the structure the third male pleopod will stand. As a result, the new species described here, H.sp.1 n.sp., is placed in the genus Haplostylus. Recent correspondence with Bacescu (pers. comm.) also confirms the need for further revision of the genera concerned.

H.(G.)bengalensis Hansen, 1910

Diagnosis. Hansen, 1910; Ii, 1964; Pillai, 1973.

Known Distribution. 23°N-4°S oceanic (Mauchline and Murano, 1977); Bay of Bengal (Hansen, 1910); Andaman Islands (W.M. Tattersall, 1922); between Ceylon and New Guinea (Zimmer, 1915); South China Sea (Ii, 1964).

Table 2.3 Comparison of species in the genus Haplostylus.

SPECIES AND REFERENCE	SPINE ON 5TH ABDOMINAL SEGMENT	ENDOPOD OF PLEOPOD 2 SEGMENTED	EXOPOD OF PLEOPOD 4 SEGMENTED	EXOPOD OF PLEOPOD 5 SEGMENTED
H.bacescui Hatzakis, 1977	-	["as in H.(G.)normani"]		
*H.(G.)bengalensis Ii, 1964	-	+	-	-
*H.(G.)brisbanensis Bacescu & Udrescu, 1982	+	+	-	-
*H.(G.)dakini W.M. Tattersall, 1940	-	+	+	+
H.(G.)erythraeus O.S. Tattersall, 1952	-	+	+	+
H.(G.)estafricana Bacescu, 1973b	-	-	+	+
*H.(G.)indicus W.M. Tattersall, 1940	-	-	-	-
H.(G.)lobatus Nouvel, 1951	-	?	?	?
H.(G.)magnilobatus Bacescu & Schiecke, 1974	-	?	?	?
H.(G.)normani O.S. Tattersall, 1952	-	+	+	+
*H.(G.)pacificus Ii, 1964	-	-	-	-
H.(G.)parerythraeus O.S. Tattersall, 1952	-	+	+	+
H.(G.)parvus O.S. Tattersall, 1952	-	+	-	-
H.(G.)pusillus O.S. Tattersall, 1952	-	+	-	-
*H.(G.)queenslandensis Bacescu & Udrescu, 1982	-	+	+	+
*H.sp.1 n.sp. Present study	+	+	+	+

* = known from Australia; ? = details not given in original description; + = present; - = absent.

Australian Records.

1) Bacescu and Udrescu (1982): Queensland, Middle Banks, Moreton Bay.

H.(G.)brisbanensis Bacescu and Udrescu, 1982

Diagnosis. Bacescu and Udrescu, 1982.

Known Distribution. Australia.

Australian Records.

1) Bacescu and Udrescu (1982): Queensland, Moreton Bay at Middle Banks and Bramble Bay.

H.(G.)dakini W.M. Tattersall, 1940

Diagnosis. W.M. Tattersall, 1940.

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1940): New South Wales, Lake Illawarra.
2) Dakin and Colefax (1940): New South Wales, Lake Illawarra.
3) Hodge (1963b): Queensland, Brisbane River.
4) South Australian Museum Collection: South Australia, Onkaparinga Estuary; 1 female, thus identification not positive.

H.(G.)indicus Hansen, 1910

Diagnosis. Hansen, 1910.

Known Distribution. 20°N-35°S oceanic (Mauchline and Murano, 1977); East Indies (Hansen, 1910); North-east of Madagascar, coast of India (W.M. Tattersall, 1912); Philippine Islands (W.M. Tattersall, 1951); Java (Delsman, 1939).

Australian Records.

1) W.M. Tattersall (1940): New South Wales, Port Stephens.
2) Dakin and Colefax (1940): New South Wales, Port Stephens and Broken Bay.
3) National Museum of Victoria Bass Strait Survey: Stations 50, 52 and 53.
4) Australian Museum Collection: Great Barrier Reef, Lizard Island, Casuarina Beach.

H.(G.)pacificus Hansen, 1912

Diagnosis. Hansen, 1912.

Known Distribution. 20°N-0° oceanic (Mauchline and Murano, 1977); Gilbert Islands (Hansen, 1912); Andaman Islands (W.M. Tattersall, 1922); Philippine Islands (W.M. Tattersall, 1951).

Australian Records.

1) Australian Museum Collection: Great Barrier Reef, Heron and Lizard Islands.

H.(G.)queenslandensis Bacescu and Udrescu, 1982

Diagnosis. Bacescu and Udrescu, 1982.

Known Distribution. Australia.

Australian Records.

1) Bacescu and Udrescu (1982): Queensland, Brisbane River.

H.sp.1 n.sp.

Type Material. HOLOTYPE: Adult male 10.0mm, National Museum of Victoria Bass Strait Survey Station 186 J11044. Dissected and drawn. PARATYPES: 4 males and 2 females, BSS Station 119, J11045 and 1 male, 1 female and 1 juvenile, BSS Station 186, J5440. All type material is lodged at the National Museum of Victoria.

Diagnosis. Carapace produced in front into a rounded rostrum (Fig. 2.20A); posterior margin deeply emarginate exposing last two thoracic segments, with small lobe present on each side close to the mid-line (Fig. 2.20B). Fifth abdominal segment with spinous process on dorsal surface (Fig. 2.20C). Eyes small extending 1/3 of first segment of antennular peduncle; pigment black. Antennular peduncle with first segment approximately same length as combined length of second and third segments. Antennal scale only slightly longer than first segment of antennular peduncle; outer margin naked terminated by distal spine beyond which apical lobe extends slightly; apex and inner lateral margin setose. Mouthparts: mandible and maxillule typical of the genus. Labrum with a large spine (Fig. 2.20D). Maxilla with 12 plumose setae on distal end of terminal segment of endopod (Fig. 2.20E). Carpo-propodus of endopod of thoracic legs 3, 4, 5, 6, 7 and 8 sub-divided into 6, 6, 8, 8, 10 and 13 segments respectively. Female pleopods: Pleopod 1 with a long slender sympod and 1 segmented endopod and exopod (Fig. 2.20F); pleopods 2-5 uniramous. First abdominal segment with pleural plate, larger in female than male. Male pleopods: endopods of pleopods 1, 3, 4 and 5 rudimentary; exopods of pleopods 1, 4 and 5 composed of 9, 6 and 4 segments respectively (Figs. 2.20G, H & I). Pleopod 2 biramous, endopod composed of 7 segments, exopod composed of 9 segments (Fig. 2.20J). Exopod of pleopod 3 composed of 7 segments, terminating in 1 barbed seta and 2 simple curved setae (Fig. 2.21A). Telson cleft, armed with approximately 15 small spines, lateral edges armed with 5 spines, pair directly behind apical spines bend

Fig. 2.20 Haplostylus sp.1 n.sp.

A Anterior of adult male.
B Posterior margin of carapace.
C 5th abdominal segment.
D Labrum.
E Maxilla.
F 1st female pleopod.
G 1st male pleopod.
H 4th male pleopod.
I 5th male pleopod.
J 2nd male pleopod.

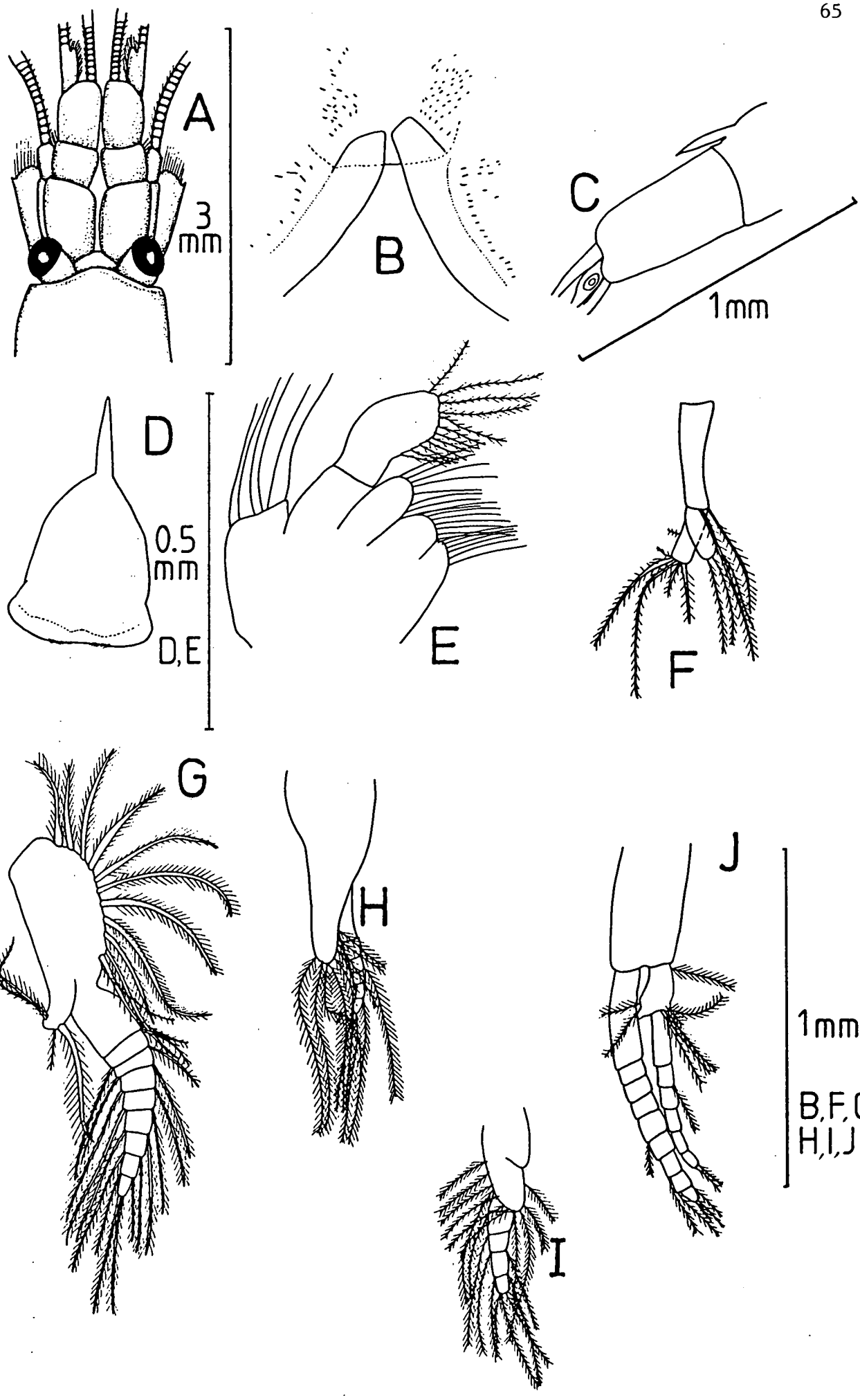
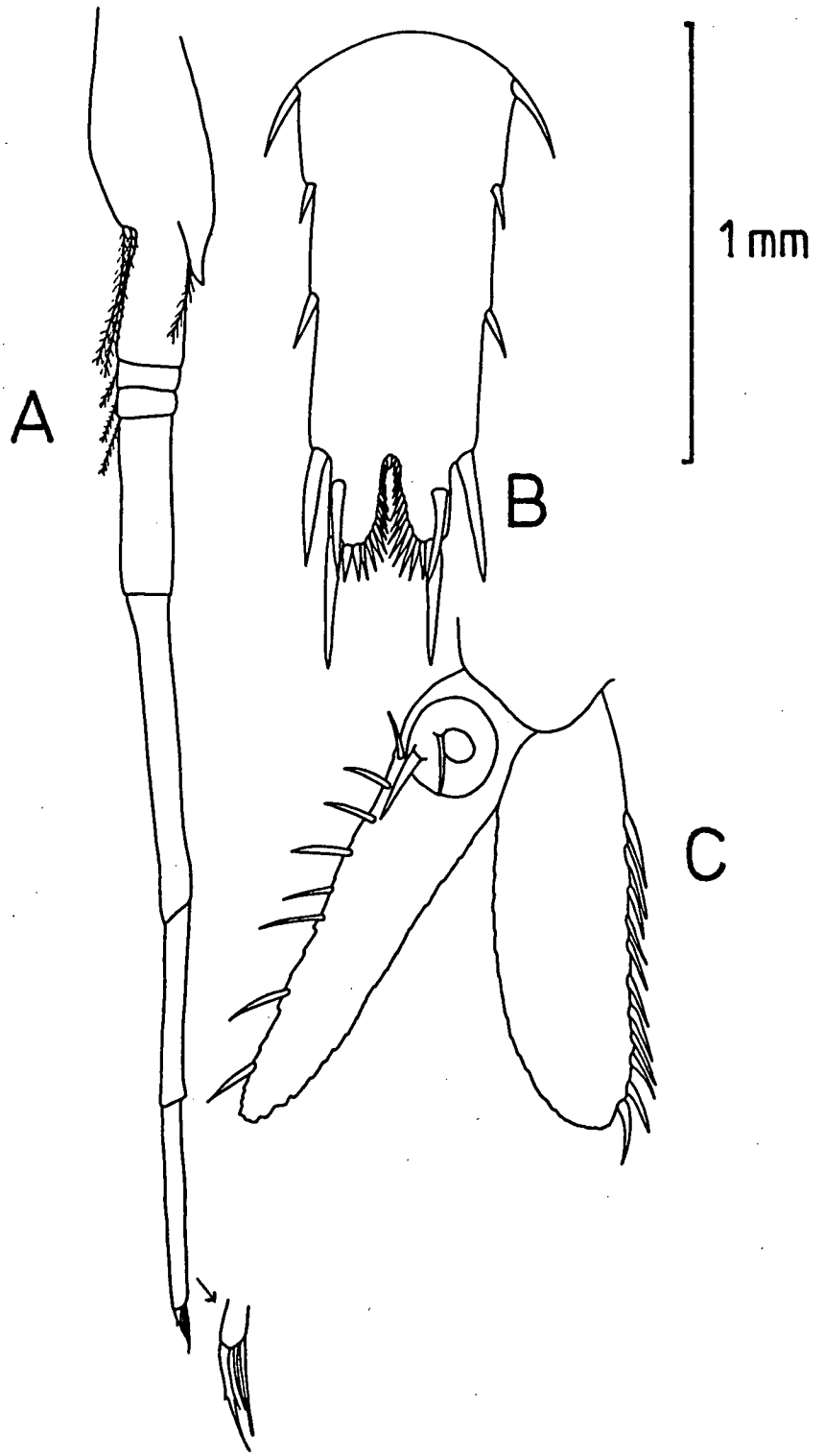

A
3
mm
B
C
1mm
D
0.5
mm
D,E
E
F
G
H
I
J
1mm
B,F,G,
H,I,J

Fig. 2.21 Haplostylus sp.1 n.sp.

A Third male pleopod.

B Telson.

C Uropods.


A
B
C
1 mm

inwards reaching same level as small cleft spines (Fig. 2.21B). Uropods: Endopod slightly longer than exopod bearing a row of 8 spines on inner margin and 2 spines on statocyst. Exopod with 12 spines on outer border (Fig. 2.21C).

Adult length: 12-13mm measured from the tip of the rostrum to the tip of the exopod of the uropod. Largest specimen caught: 13.4mm adult male.

Remarks. H.sp.1 n.sp. is easily distinguished from all other members of the genus, except H.(G.)brisbanensis, by the presence of a spinous process on the dorsal surface of the fifth abdominal segment. However, the armature of the telson and uropods and the structure of the fifth male pleopod clearly distinguish H.sp.1 n.sp. from H.(G.)brisbanensis. The telson of H.sp.1 n.sp. bears 5 lateral spines, the distal pair inwardly curved, whereas, the lateral margins of the telson of H.(G.)brisbanensis bear 8-9 spines and the distal pair of spines do not curve inwardly (Fig. 2.18D). In addition, the number of spines present on the inner margin of the endopod and on the outer margin of the exopod of the uropod are 6 and 13-18 in H.(G.)brisbanensis (Fig. 2.18E) and 8 and 12 for H.sp.1 n.sp. respectively. Perhaps one of the major differences is in the fact that both exopods of male pleopods 4 and 5 are segmented in H.sp.1 n.sp., but only the exopod of pleopod 4 is segmented in H.(G.)brisbanensis (Fig. 2.18C). Other differences include the structure of the terminal setae of pleopod 3 (compare Figs. 2.18F and 2.21A) and the number of segments forming the carpopropodus of the thoracic legs.

Known Distribution. Australia.

Australian Records.

1) Dakin and Colefax (1940): New South Wales, Broken Bay coastal plankton; common in summer months. Unnamed species.
2) National Museum of Victoria Bass Strait Survey: Stations 55, 75, 118, 119, 120, 121, 184, 186 and 206.
3) Tasmania: Bruny Island at One Tree Point.

iv) Genus Paranchialina Hansen, 1910

Diagnosis. Body slender. Carapace short leaving most of last 2 thoracic segments exposed; antero-lateral angles acute and prominent. Telson narrow, armed with spines along lateral margins; cleft deep and narrow armed with small spines. Uropods: inner margin of endopod with row of numerous spines; exopod with 2 spines mid-way along outer margin, proximal half-naked, distal half-setiferous. Pleopods, female pairs 1-3 normal styliform, pairs 4 and 5 broad and short; male pairs 1 and 5 uniramous, pairs 2-4 biramous;

exopod of pleopod 3 elongated (Hansen, 1910; Hale, 1929).

Remarks. Only one species is known in this genus, P.angusta, which has only been recorded from Australian waters.

P.angusta (G.O. Sars, 1883)

Diagnosis. Antennal scale small, approximately 1/2 length of antennular peduncle. Thoracic endopods 3-8 slender, propodus sub-divided into 7 sub-segments. Telson narrow, 3.5 times as long as its basal width; apical cleft deep and narrow; apical lobes with 1 spine longer than others; lateral margins with 15-30 spines depending on body size. Body surface minutely hispid (W.M. Tattersall, 1927; Hale, 1929).

Known Distribution. Australia.

Australian Records.

1) G.O. Sars (1883): Victoria, Port Phillip Bay; recorded as Anchialina angustus.
2) W.M. Tattersall (1927): South Australia, Gulf of St. Vincent.
3) South Australian Museum: South Australia, near Port Pirie and Outer Harbour.
4) National Museum of Victoria Bass Strait Survey: Stations 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 154, 156, 158, 164, 171, 180, 181, 184, 194, 201, 202, 205 and 207. It was the most common species found in the Bass Strait Survey.
5) Tasmania: D'Entrecasteaux Channel and Chinamans Bay Maria Island.

v) Genus Pseudanchialina Hansen, 1910

Diagnosis. Abdomen slender compared to Anchialina. Pleura of male abdominal segments not specialised; sometimes first abdominal segment of female with pleura almost as in Anchialina, but with pleural plate directed obliquely forward compared to obliquely backward in Anchialina. Antennal scale with spine on outer margin, larger than that of Anchialina. Endopod of second and third thoracic limbs similar in both sexes. Propodus of thoracic endopods 3-8 divided into 3 sub-segments. Female pleopods rudimentary, simple and styliform. Male pleopods 1, 4 and 5 rudimentary, unjointed and styliform. Pleopods 2 and 3 biramous, endopod short and unsegmented, exopod elongated with 2 segments. Telson with spines of uniform size evenly distributed along lateral borders; fewer lateral spines and shallower apical cleft than in Anchialina. Uropods: endopod without a row of spines along inner margin; exopod with a single distal spine, remainder of outer margin naked (Ii, 1964).

Remarks. Mauchline (1980) lists four species in the genus. However, their status was discussed by Pillai (1973) and again by Valbonesi and Murano (1980), and they concluded that there are only two true species, i.e. P.inermis and P.pusilla. Both of these species have been recorded from Australian waters.

Key to the Australian Species of Pseudanchialina

1. Rostrum linguiform (Fig. 2.22A). Lateral borders of telson with 4-5 spines (Figs. 2.22B & C). Endopod of uropod with 1 conspicuous spine mid-way along inner margin. Female with pleural plate on first abdominal segment. ..... P.inermis

--- Rostrum broad, squarish (Fig. 2.22D). Lateral borders of telson with 7-9 spines (Figs. 2.22E & F). Endopod of uropod without spines. Female pleural plate not developed. ..... P.pusilla

Pseudanchialina inermis (Illig, 1906)

Diagnosis. Pillai, 1973.

Known Distribution. 29°N-20°S (Mauchline and Murano, 1977); Indian Ocean, east of Ceylon and west of Sumatra (Illig, 1906); Tanzania (as P.erythraea); Tanabe Bay, Japan (Valbonesi and Murano, 1980).

Australian Records.

1) Pillai (1973): West coast of Australia, Stations 224 and 248.
2) Sale et al. (1978): Great Barrier Reef, Heron Island.
3) Australian Museum Collection: Great Barrier Reef, Heron Island.

P.pusilla (G.O. Sars, 1883)

Diagnosis. G.O. Sars, 1883; O.S. Tattersall, 1960; Pillai, 1973.

Known Distribution. 15°N-15°S (Mauchline and Murano, 1977); Celebes Sea (G.O. Sars, 1883); East Indies and Bay of Bengal (Hansen, 1910); Singapore (O.S. Tattersall, 1960); Arabian Sea (Pillai, 1964).

Australian Records.

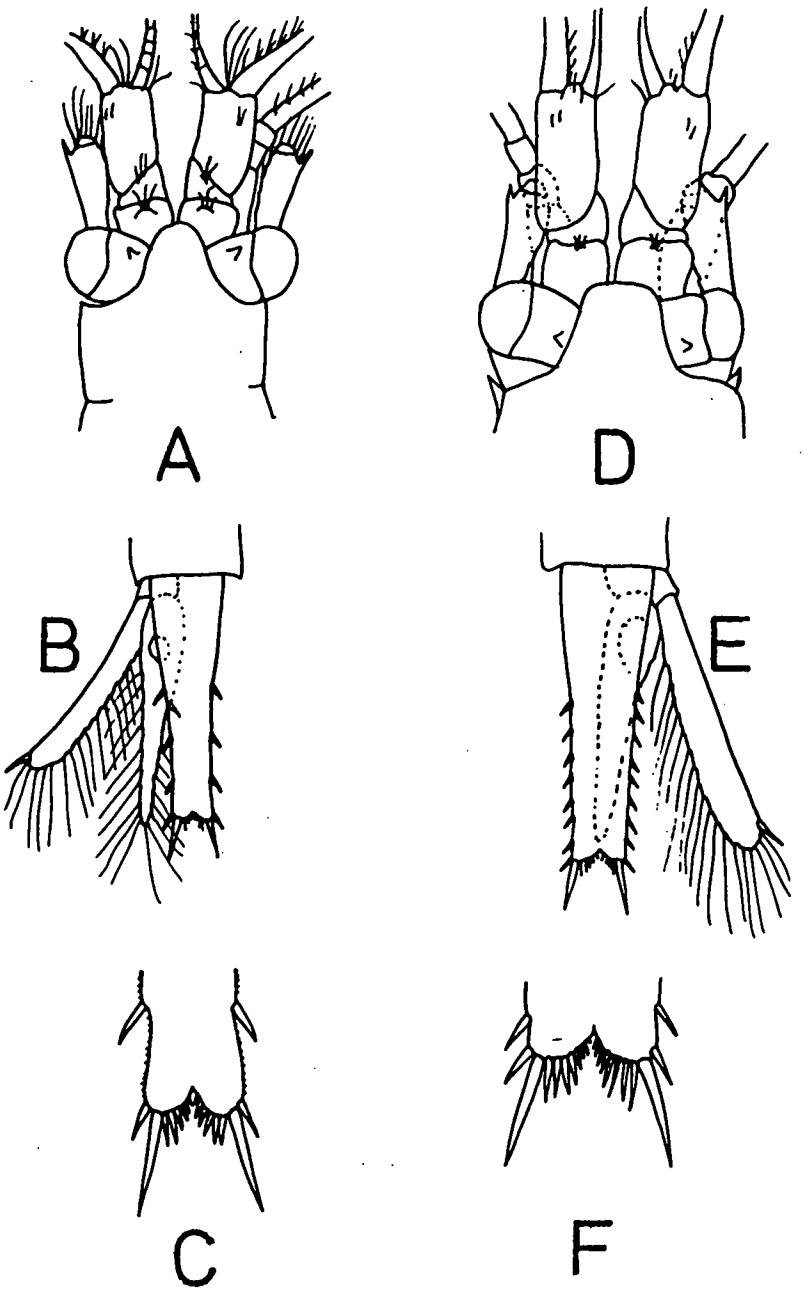
1) W.M. Tattersall (1936a): Great Barrier Reef at Low Isles Flats and Low Isles Anchorage.
2) Pillai (1973): West coast of Australia, Stations 240 and 362.

2.3.3.3.5 Sub-Family MYSINAE

Definition. Labrum of normal shape, rounded behind, usually broader than long, generally without anteriorly directed spiniform process. Propodus of

Fig. 2.22 Genus Pseudanchialina

A Pseudanchialina inermis anterior of male.
B P.inermis telson and uropods.
C P.inermis telson cleft.
(Figs. A, B & C after Pillai, 1973 Figs. 37A & B respectively; no scale provided).
D P.pusilla anterior of male.
E P.pusilla telson and uropod.
F P.pusilla tip of telson.
(Figs. D, E & F after Pillai, 1973 Figs. 36A, B & C respectively; no scale provided).


A
D
B
E
C
F

third to eighth thoracic endopods either distinct from carpus and secondarily divided, or fused with carpus and the fused carpo-propodus secondarily sub-divided. Male pleopods variously modified; those of female usually rudimentary. First abdominal segment of female without lamellae. Uropods: exopod and endopod undivided; endopod shorter than exopod; outer margin of exopod setose. Female brood pouch formed by 2-3 pairs of lamellae (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. The large number of genera belonging to this sub-family are divided amongst four Tribes: Erythropini, Leptomysini, Mysini and Heteromysini. All of these Tribes are represented in Australian waters.

A) Tribe Erythropini

Definition. Antennal scale usually with a pronounced spine on outer margin or, if absent, with only a few setae on distal half; scale absent or styliform in a few genera. Thoracic endopods with carpus distinct, separated by an oblique articulation in most genera; transverse in Arachnomysis and some Pseudomma species. Propodus usually with 2 segments. Male pleopods: first pair rudimentary or with reduced endopod. Pairs 2-5 well-developed, biramous; exopod of fourth pair rarely and at most only slightly elongated; in several genera exopod or endopod or both with modified setae. In a few genera all pleopods rudimentary as in female. Female brood pouch formed by 2-3 pairs of lamellae. Telson usually entire (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. The majority of this Tribe is represented by pelagic or deep-sea species, often quite unusual in appearance. The fact that, of the 41 genera known to belong to the Tribe (Mauchline, 1980) 11 are monospecific, clearly shows the diversity existing. Nine genera have been recorded from Australia, and of these only one, Australerythrops, is monospecific although Bacescu and Udrescu (1984) indicate that another species in this genus is currently being described. However, all the other genera have only 1 Australian representative.

i) Genus Australerythrops W.M. Tattersall, 1928

Diagnosis. Eyes large. Antennal scale with prominent distal spine extending beyond apex; outer margin naked; no distal articulation. Propodus of thoracic endopods 4-7 divided into 4 sub-segments by transverse articulations; third thoracic endopod with first of these sub-segments further divided by an oblique articulation. Telson entire, linguiform. Distal half of lateral borders and apex armed with numerous closely set spines; no

plumose setae at apex. Endopod of uropod with a row of stout spines along inner margin. Male pleopods: first pair rudimentary as in female; pairs 2 and 3 biramous, rami sub-equal in length without modified setae; pairs 4 and 5 biramous, endopod considerably longer than exopod, some terminal setae modified; endopod of pleopod 5 longer than that of pleopod 4. Female brood pouch formed by 3 pairs of lamellae (W.M. Tattersall, 1928).

Remarks. This monospecific genus is known only from Australia.

Australerythrops paradicei W.M. Tattersall, 1928

Diagnosis. Rostral plate evenly rounded, leaving eyes and eyestalks uncovered. Eyes large, spherical, pigment black. Antennal scale slightly longer than antennular peduncle; outer margin naked with terminal spine (Fig. 2.23A). Lateral margins of distal half of telson armed with 30-35 small closely set spines; apex broadly rounded with shorter spines. Uropod: endopod longer than telson, inner margin with a row of approximately 23 spines extending from statocyst to apex (W.M. Tattersall, 1928).

Known Distribution. Australia.

Australian Records.

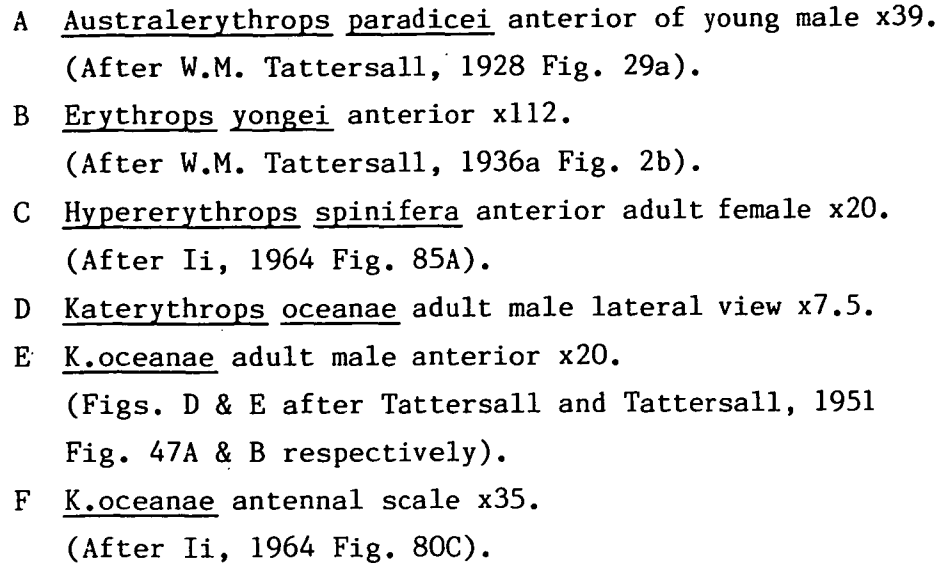
1) W.M. Tattersall (1928): New South Wales, Watson's Bay Port Jackson; found in dark crevices among rocks at low tide on the shore.
2) Tasmania: Eaglehawk Neck Clydes Island at cave entrance; collected by J.Bryan.

ii) Genus Erythrops G.O. Sars, 1869

Diagnosis. Body form generally slender and delicate. Eyes well-developed, cornea usually reniform and dorso-ventrally compressed; pigment usually red. Antennular peduncle of male larger than in female; proximal segment of male produced into hirsute lobe. Antennal scale with outer margin naked, straight or coarsely serrated, with strong terminal spine. Endopod of thoracic legs 3-8 with distinct carpus separated from 2 segmented propodus by very oblique articulation. Male pleopods: first pair rudimentary, pleopods 2-5 biramous and well-developed. Uropods: both exopod and endopod undivided, setose along lateral and medial borders. Inner margin of endopod sometimes minutely serrated. Telson short, entire, trapeziform with truncate apex; lateral margins unarmed, apex with 2 pairs of stout spines and a pair of plumose setae. Female with 2 pairs of brood lamellae (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. Fifteen species are known (Mauchline, 1980), of which only one is recorded from Australian waters.

Fig. 2.23 Tribe Erythropini



A Australerythrops paradicei anterior of young male x39.
(After W.M. Tattersall, 1928 Fig. 29a).

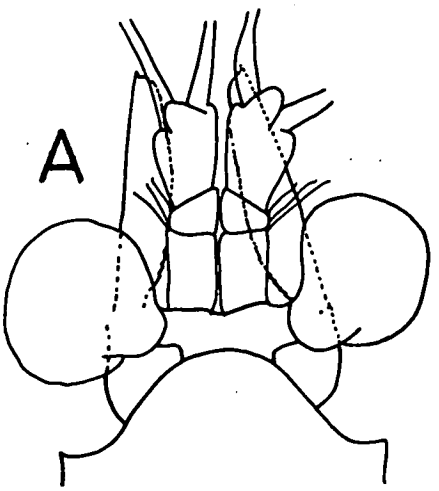
B Erythrops yongei anterior x112.
(After W.M. Tattersall, 1936a Fig. 2b).

C Hypererythrops spinifera anterior adult female x20.
(After Ii, 1964 Fig. 85A).

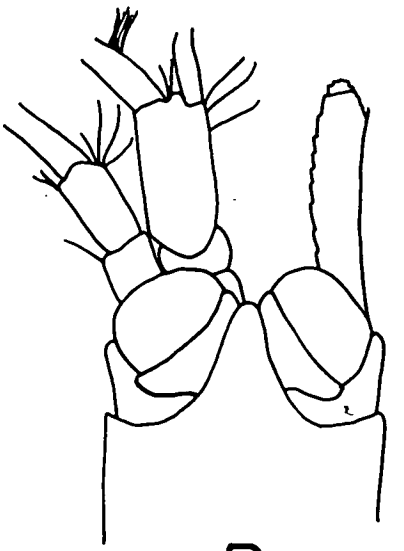
D Katerythrops oceanae adult male lateral view x7.5.

E K.oceanae adult male anterior x20.
(Figs. D & E after Tattersall and Tattersall, 1951 Fig. 47A & B respectively).

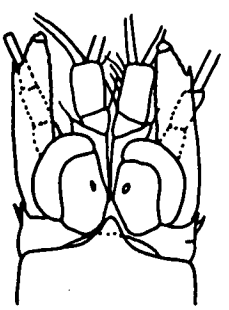
F K.oceanae antennal scale x35.
(After Ii, 1964 Fig. 80C).



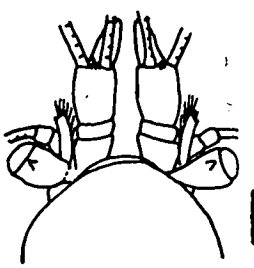
A



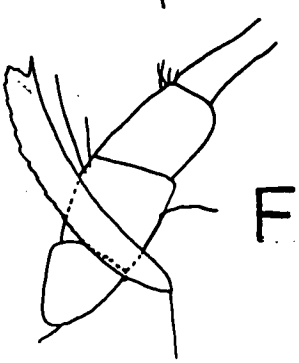
B



C

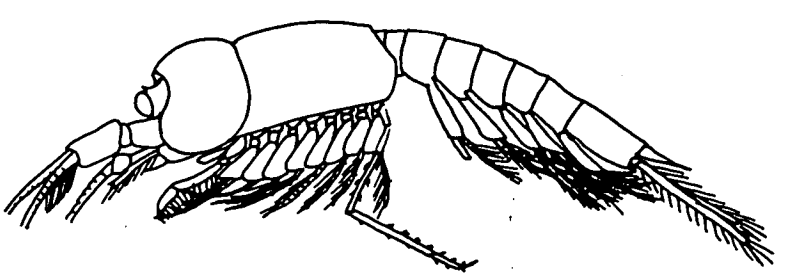


E



F

D



Erythrops yongei W.M. Tattersall, 1936a

Diagnosis. Typical of genus except: eyes small, not depressed or kidney shaped, rather sub-globose; pigment black. Rostrum moderately long, obtuse, extending forwards nearly to distal margin of eyes. Antennal scale narrow; outer margin with terminal spines beyond which apex extends. Telson as in Fig. 2.5G, apex armed with 2 pairs of spines and a pair of plumose setae broken in figure so their length could not be determined (W.M. Tattersall, 1936a).

Known Distribution. This species has only been collected on two occasions, once from the type locality and secondly from the Philippine Islands; both times only 1 damaged female was collected. Consequently, a detailed description is not available.

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, outside Papuan Pass.

iii) **Genus** Euchaetomera G.O. Sars, 1883

Diagnosis. Carapace with small rostrum rounded or acute. Eyes large, cornea divided into lateral and anterior portions. Antennal scale usually longer than antennular peduncle; outer margin naked with terminal spine. Thoracic limbs essentially as in Erythrops. First pair of male pleopods rudimentary, pairs 2-5 well-developed and biramous, no distal setae modified. Telson short, triangular; apex truncate armed with 1-2 pairs of small spines and pair of plumose setae; lateral margins may or may not have spines (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. Eight species are known in this genus (Mauchline, 1980). The first record of this genus from Australian waters was by Pillai (1973); unfortunately species identification was not possible since only 1 juvenile was caught.

Euchaetomera sp.

Australian Records.

1) Pillai (1973): West coast of Australia, Station 222; 1 juvenile only, thus species not identified.

iv) **Genus** Euchaetomeropsis W.M. Tattersall, 1909

Diagnosis. Eyes elongate; cornea divided into anterior and postero-lateral areas. Antennal scale lanceolate, setose all round, lacking spine at distal end of outer margin (Fig. 2.5F). Telson short, about as long as broad;

distal margin truncate with one spine at each corner and a pair of median plumose setae (Taniguchi, 1974; Murano, 1977).

Remarks. Essentially as in the genus Euchaetomera, except in the shape of the antennal scale. Two species are known in the genus Euchaetomeropsis (Mauchline, 1980); one has been recorded from Australia.

E.merolepsis (Illig, 1908)

Diagnosis. Abdomen long, nearly 1.7 times longer than cephalothorax. Carapace with shallow posterior emargination, 1/5 to 1/6 of carapace length. Molar process of mandible with fine setae.

Known Distribution. 40°N-40°S mesopelagic (Mauchline and Murano, 1977); Indian Ocean (Illig, 1930; Taniguchi, 1974); Atlantic Ocean (Zimmer, 1914; Illig, 1930; O.S. Tattersall, 1955); Pacific Ocean (W.M. Tattersall, 1943; Murano, 1977); Mediterranean Sea (W.M. Tattersall, 1909; Nouvel, 1942).

Australian Records.

1) Taniguchi (1974): West coast of Western Australia.

v) Genus Gibberythrops Illig, 1930

Diagnosis. Eyes normal, not depressed dorso-ventrally. Thorax without ventral sternal processes. Telson triangular, elongate; apex narrow with 1 pair of long spines and plumose setae. Lateral margin of telson armed distally with small spines progressively increasing in length toward apex. Endopod of male pleopods with slender pseudobranchial processes (Murano, 1981).

Remarks. Three species, G.acanthura, G.typicus and G.stephensoni, are known (Murano, 1981). Only the latter species has been collected from Australia.

G.stephensoni (W.M. Tattersall, 1936a)

Diagnosis. Rostral plate virtually absent. Antennal scale long and narrow, 6-7 times as long as broad; outer margin naked terminating in a strong spine extending beyond apex of scale. Telson with 11 stout spines arming distal 2/5 of lateral margins. Proximal to spines telson is constricted slightly (W.M. Tattersall, 1936a; Murano, 1981).

Known Distribution. Amashi-Oshima Island, south-western Japan (Murano, 1981).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, outside Trinity Opening, Station 29. NB: Apical plumose setae were missing.

vi) Genus Hypererythrops Holt and Tattersall, 1905

Diagnosis. General body form slender. Rostrum rounded, produced slightly between eyes. Antennular peduncle as in Erythrops. Antennal scale well-developed, extends beyond antennular peduncle; outer margin entire, terminated by strong spine beyond which apex may or may not extend; small distal articulation. Eyes large; stalk narrow proximally widening rapidly with small ocular papilla near cornea. Thoracic limbs as in Erythrops. Male pleopods with broad flat branchial plate. Pleopod 1 rudimentary, pairs 2-5 biramous, well-developed. Telson longer than in Erythrops; triangular, longer than broad; lateral margins armed with spines on whole length or distal 3/4; apex truncate with 3 pairs of stout spines, central pair usually longest, and a pair of small spines and plumose setae. Inner margin of endopod of uropod with 1-2 spines. Male with ventral process on at least 6 thoracic and some abdominal segments (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. Six species are known (Mauchline, 1980); one has been collected from Australian waters.

Hypererythrops spinifera (Hansen, 1910)

Diagnosis. Rostrum small, triangular; apex sub-acutely rounded. Supra-ocular spines absent. Anterior of adult female as in Fig. 2.23C. Telson slightly longer than its basal width; 13-14 spines arm lateral margins; apex broadly truncate, armed with 2 pairs of long spines and pair of median small spines; median plumose setae broken in figured telson (Fig. 2.6A) (Ii, 1964; Pillai, 1964).

Known Distribution. 35°N-15°S coastal (Mauchline and Murano, 1977); East Indies (Hansen, 1910); Andaman Islands (W.M. Tattersall, 1922); Tsushima Strait (Ii, 1964); Tanabe Bay (Valbonesi and Murano, 1980).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, outside Trinity Opening and Reef Lagoon.

vii) Genus Katerythrops Holt and Tattersall, 1905

Diagnosis. General body form robust. Eyes normally developed or without pigment. Carapace much wider than abdomen; rostrum obtusely rounded; cervical region greatly inflated, separated from thoracic region by deep sulcus. Sixth abdominal segment almost twice as long as other abdominal segments. Antennal scale short, narrow and feeble; outer margin smooth, small terminal spine; no distal articulation. Thoracic limbs long and slender segmentation as in Erythrops. Pleopods as in Erythrops; no modified

setae. Uropods: endopod shorter than exopod in adults, sub-equal in juveniles. Inner margin of endopod without spines. Telson short, triangular with apex narrowly truncate; lateral margins unarmed and slightly concave; apex with 2 pairs of spines, pair of plumose setae may or may not be present.

Remarks. Four species are known (Mauchline, 1980); one has been collected from Australian waters.

Katerythrops oceanae Holt and Tattersall, 1905

Diagnosis. Carapace with cephalic region inflated (Fig. 2.23D). Eyes small, widely separated; minute papilla at dorsal edge of cornea (Fig. 2.23E). Antennal scale short, narrow, outwardly curved; slightly longer than antennal peduncle (Fig. 2.23F), shorter than antennular peduncle. Telson sub-triangular; apex narrowly truncate armed with 2 pairs of spines, inner pair longer than outer (Tattersall and Tattersall, 1951; Ii, 1964).

Known Distribution. 52°N-35°S depth range 200-3000m (Mauchline and Murano, 1977); widely distributed in North and South Atlantic and Indian Oceans (Tattersall and Tattersall, 1951); Japan (Ii, 1964).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef outside Trinity Opening, 1 member of the genus too badly damaged for identification.
2) O.S. Tattersall (1955): Western Australia, west of Perth between 300-2000m; Station 1739.

viii) Genus Pseudomma G.O. Sars, 1870

Diagnosis. General form slender, similar to Erythrops. Rostrum evenly rounded; no projection. Eyes rudimentary without pigment or visual elements, united forming a single flattened plate with median notch. Antennular peduncle short; distal segment longer than other two combined; male lobe hirsute. Antennal scale short; outer margin naked; terminal spine beyond which apex may or may not extend. Endopod of thoracic limbs 3-8 slender and fragile, carpus divided from propodus usually by oblique but sometimes a transverse articulation; dactylus small, densely hirsute with or without nail. Male pleopods well-developed, biramous; endopod of first pair unsegmented; endopod of fourth pair sometimes elongated and with modified setae. Telson truncate linguiform, entire; lateral margins unarmed or armed with 3-15 small spines. Apex armed with 4-10 strong spines. Endopod of uropod shorter than exopod, sometimes with 1-2 small spines near statocyst (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. Members of this genus are usually associated with deep water;

species have been collected from 20-3000m (Mauchline and Murano, 1977). Thirty-four species are known (Mauchline, 1980), only one of which has been collected from Australian waters.

Pseudomma australe G.O. Sars, 1885

Diagnosis. Ocular plates with median divisions; outer edge smooth. Antennal scale lanceolate; inner corner projecting greatly; outer corner with spines near base (G.O. Sars,1885).

Known Distribution. Australia.

Australian Records.

1) G.O. Sars (1885): Victoria, Port Phillip Bay.
2) National Museum of Victoria Bass Strait Survey: Stations 164, 165, 167 and 169.

ix) Genus Synerythrops Hansen, 1910

Diagnosis. Closely allied to Hypererythrops. Thoracic and abdominal segments without sternal processes. Eyes normally developed; ocular papilla sometimes present. Antennal scale with outer margin naked; terminal spine; apical lobe small. Mandibular palp with second segment broad and expanded. Endopod of first thoracic limb with lobe on second and third segments. Thoracic legs 2-8 and male pleopods essentially as in Erythrops; male pleopods with pseudobranchial process elongate forming long narrow lobe. Telson short, triangular; apex broadly rounded; lateral margins armed with spines, mostly confined to distal half; apex armed with 1 pair of long spines and 1 pair of plumose setae, no median small spines. Endopod of uropod sometimes with spines (Hansen, 1910; Ii, 1964).

Remarks. Three species are known in the genus (Mauchline, 1980), one has been recorded in Australian waters.

Synerythrops intermedia Hansen, 1910

Diagnosis. Eyes slightly depressed, reniform as in Erythrops. Telson with 6-7 spines on distal lateral margins. Antennal scale as in Fig. 2.6D (W.M. Tattersall, 1936a). NB. Hansen (1910) described the eyes as sub-globose and reported fewer lateral spines on the telson.

Known Distribution. 35°N-15°S (Mauchline and Murano, 1977); Manipa Strait, East Indies (Hansen, 1910); Gulf of Aden (W.M. Tattersall, 1939).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, outside Trinity Opening, Station 29.

B) Tribe Leptomysini

Diagnosis. Antennal scale lanceolate; setae along lateral and medial borders. Endopod of thoracic limbs 3-8 with carpus and propodus fused and sub-divided into sub-segments by transverse articulations; sometimes by proximal oblique and distal transverse articulations. Male pleopods 2-5 usually well-developed (rudimentary in Mysidetes and Pseudomysidetes). Exopod of pleopod 4 more or less elongated and with modified setae; endopod normal (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. Twenty-two genera are known within this tribe (Mauchline, 1980). Of these, nine have been recorded from Australia. In addition, a new genus is described here.

i) Genus Allomysis n.g.

Diagnosis. Eyes normally developed. Dorsal fin present on carapace. Antennular peduncle of male without "drop-like" organ found in Leptomysis australiensis (Wittmann pers. comm. proposes to erect a new genus to accept this species). Antennal scale broad, lateral and medial borders setose; small distal articulation. Labrum normal, without spiniform process. Mandible with molar process reduced. Mandibular palp thick and fleshy, medial and distal segments with spines. Maxilla and maxillule unusual each with additional exite bearing scales. First thoracic endopod without endites; segments 2 and 3 distinct as in genus Leptomysis, second segment very short. Carpo-propodus of thoracic endopods 3-8 composed of 3 sub-equal segments, separated by transverse articulations. Female brood pouch formed by 3 pairs of lamellae. Female pleopods rudimentary, uniramous in form of expanded plates, posteriorly increasing in size. First male pleopod uniramous; pairs 2-5 biramous with distinct broad branchial plate on basal segment of endopod. Exopod of pleopod 4 with single strong seta arising from antepenultimate and penultimate segments; terminal segment with 2 simple setae. Telson entire, triangular; lateral margins partly armed with small spines; apex acute with 2 spines. Ventral surface with numerous long plumose setae. Inner margin of endopod of uropod without spines.

Etymology. From the Greek allo meaning another; this name is provisionally used within this thesis.

Type species. Allomysis sp.1 n.g. n.sp.

Remarks. Allomysis n.g. bears similarities to the sub-genera Pseudomysidopsis and Mysidopsoides created by Bacescu and Gleye (1979), with the presence of spines on the mandibular palp and projections on the dorsal surface of the carapace. However, the structure of the palp in Allomysis

n.g. is quite different; it does not have the proximal expansion of the median segment with 2 prominent spines found in M.camelina (Pseudomysidopsis s.g.) or the elongate narrow median segment with a few distal spines found in M.bispinosa (Mysidopsoides s.g.). Both these sub-genera are described from female specimens only, consequently until males are found they are allied to Mysidopsis mainly on the basis of the similar structure of the first thoracic limb, with segments 2 and 3 fused, and the similar structure of the other appendages. Their separation into sub-genera is due to their unusual mandibular palps (Bacescu and Gleye, 1979).

The presence of a fin on the dorsal surface of the carapace in Allomysis n.g. is unusual, although M.camelina (Pseudomysidopsis s.g.) bears 2 dorsal "humps"; Mysidopsis indica bears 3 dorsal "nodules"; M.erimita bears 1 "nodule" and M.gibbosa bears 2 "nodules". The term nodule or hump implies a thickness not exhibited in the new genus Allomysis. Of these species only the description of M.indica includes a description of a male; the pleopod structure is typical of the genus Mysidopsis and not like that of Leptomysis (Ii, 1964). On the other hand, the fourth male pleopod of Allomysis is essentially the same as that of L.australiensis. In fact the new genus is probably closely related to L.australiensis (Notomysis n.g.; Wittmann, in prep.) since similarities exist in the structure of the fourth male pleopod, the segmentation of the first thoracic leg and presence of plumose setae on the ventral surface of the telson. However, the telson of Allomysis n.g. is entire without the apical incision found in L.australiensis, the drop-like organ present on the male antennular peduncle is not present in Allomysis n.g. and importantly the structure of the mandibular palp, maxilla and maxillule of Allomysis n.g. are quite different (Wittmann, pers. comm.). The combination of features clearly separate the new genus from all other genera in the Tribe Leptomysini.

Allomysis sp.1 n.g. n.sp.

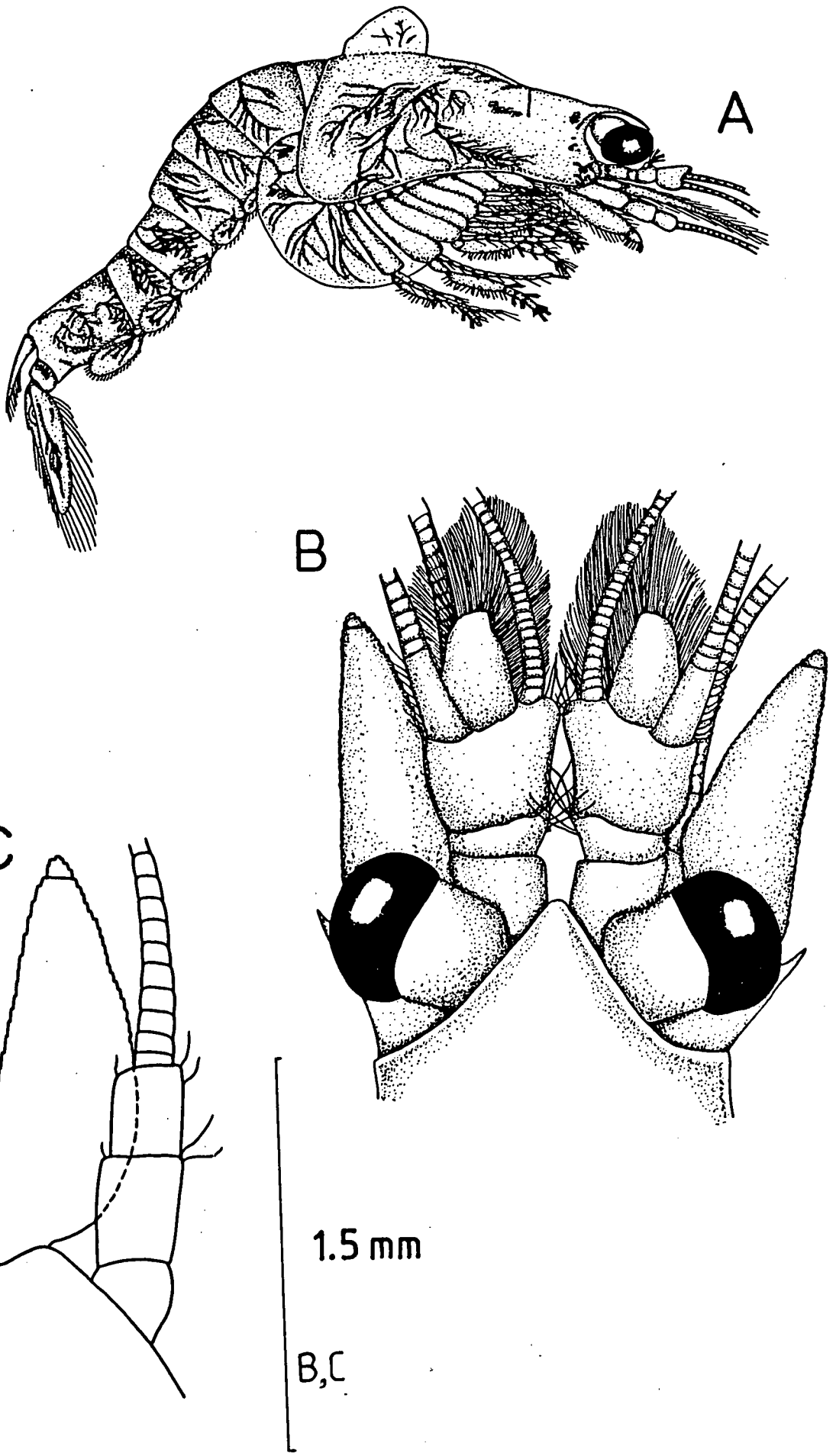
Diagnosis. Body form robust. Carapace posteriorly exposing last thoracic segment. Rostrum acute bending down between eyes; antero-lateral margins rounded. Prominent fin present, located on dorsal surface of carapace, behind cervical sulcus between thoracic segments 3 and 6 rising perpendicular to carapace surface (Fig. 2.24A). Eyes well-developed, short, extending to end of second segment of antennular peduncle; pigment black (Fig. 2.24B). Antennal scale oval, 3 times as long as broad, approximately twice as long as antennular peduncle; setose along lateral and medial borders; small distal articulation. Antennal peduncle approximately half length of scale, outer margin of base with outwardly directed slender apophysis

Fig. 2.24 *Allomysis sp.1* n.g. n.sp.

A Adult female, lateral view, 12.2mm in length.

B Anterior of adult male.

C Antennal scale.


A
B
C
1.5 mm
B,C

(Fig. 2.24C). Antennular peduncle of male with hirsute lobe longer than terminal segment of peduncle. Labrum rounded, without spiniform process (Fig. 2.25A). Mandible with molar process under-developed (Fig. 2.25B). Mandibular palp thick and fleshy, median segment 3 times as long as distal segment; both distal and medial segments with spines on inner lateral margin (Fig. 2.25C). Maxillule and maxilla with additional exite (Figs. 2.26A & B); exite of maxilla with many scales; exite of maxillule with a few scales. First thoracic endopod composed of 6 segments, segments 2 and 3 not fused; endites absent (Fig. 2.26C). Second thoracic endopod with strong nail (Fig. 2.26D). Thoracic endopods 3-7 robust with carpo-propodus composed of 3 sub-equal segments and small terminal segment (Fig. 2.27A); eighth thoracic endopod without small terminal segment (Fig. 2.27B). Strong dense setae present on all thoracic legs. Male appendage at base of eighth thoracic leg (Fig. 2.27C). Female brood pouch formed by 3 pairs of lamellae. Pleopods of female rudimentary, endopod expanded into branchial plate posteriorly increasing in size. First male pleopod uniramous; pairs 2-5 biramous both endopod and exopod composed of many segments; branchial plate distinct. Pleopod 4 with 12-segmented endopod and 13-segmented exopod; antepenultimate and penultimate segments bear single strong seta, terminal segment with 2 simple setae (Fig. 2.27D). Telson entire, triangular; lateral borders armed with 16-18 spines along approximately 4/5 of length stopping prior to apex; apex armed with 2 spines (Fig. 2.28A). Ventral surface of telson armed with approximately 16 plumose setae, extending along mid-line from about mid-way along length to apex (Fig. 2.28B). Uropods: endopod longer than telson; blunt projection on statocyst; inner margin with several plumose setae but no spines (Fig. 2.28C). Exopod slightly longer than endopod. Both endopod and exopod setose along lateral and medial borders.

Adult length: 10-13mm measured from the tip of the rostrum to the distal end of the exopod of the uropod.

Pigmentation: sandy-dark brown, body surface hispid.

Remarks. The differences in the size of the fin can be seen in Table 2.4 with varying length and stage of development. In general, it seems that the female has a larger fin than does the male.

Known Distribution. Australia.

Australian Records.

1) Tasmania: Hope Beach, South Arm, collected by dredge 100m off-shore behind breaker zone of the surf beach.
2) Tasmania: Bruny Island, One Tree Point.

Fig. 2.25 *Allomysis sp.1* n.g. n.sp.

A Labrum.

B Mandibles.

C Mandibular palp.

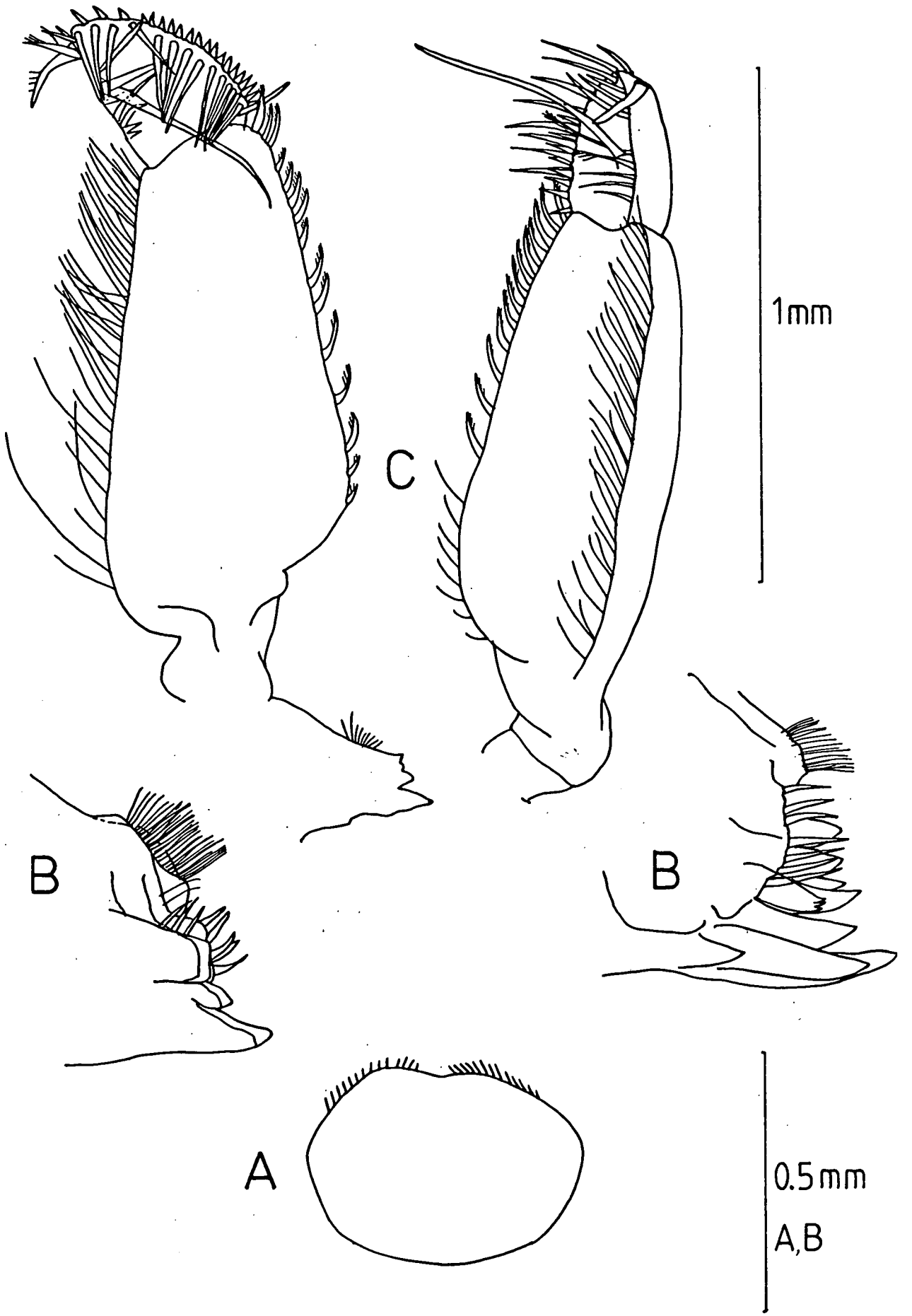

1mm
C
B
B
A
0.5mm
A,B

Fig. 2.26 *Allomysis sp.1* n.g. n.sp.

A Maxillule.

B Maxilla.

C First thoracic leg.

D Second thoracic leg.

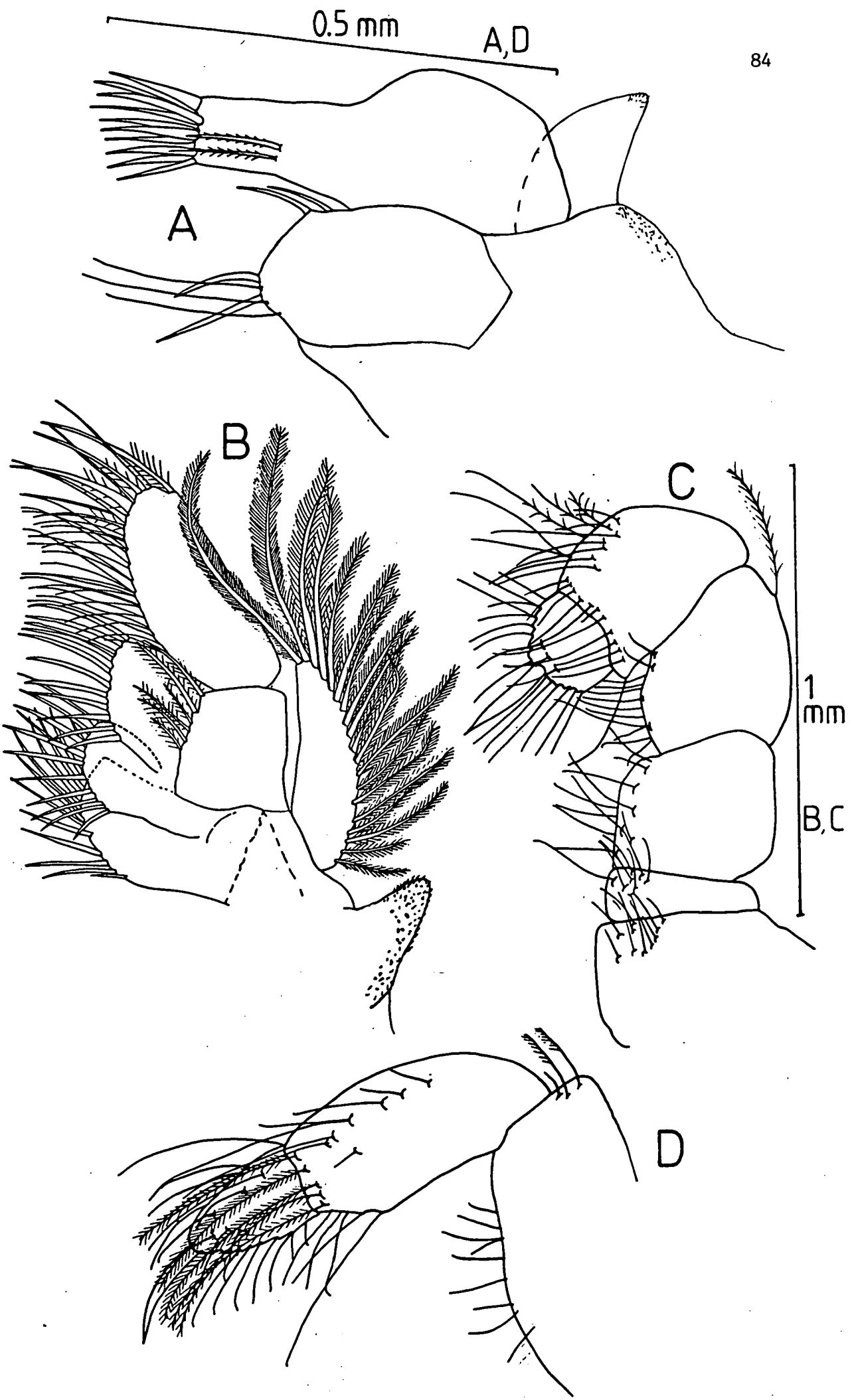

0.5 mm
A,D
A
B
C
1
mm
B,C
D

Fig. 2.27 Allomysis sp.1 n.g. n.sp.

A Third thoracic leg.
B Eighth thoracic endopod.
C Male genital appendage.
D Male pleopod 4.

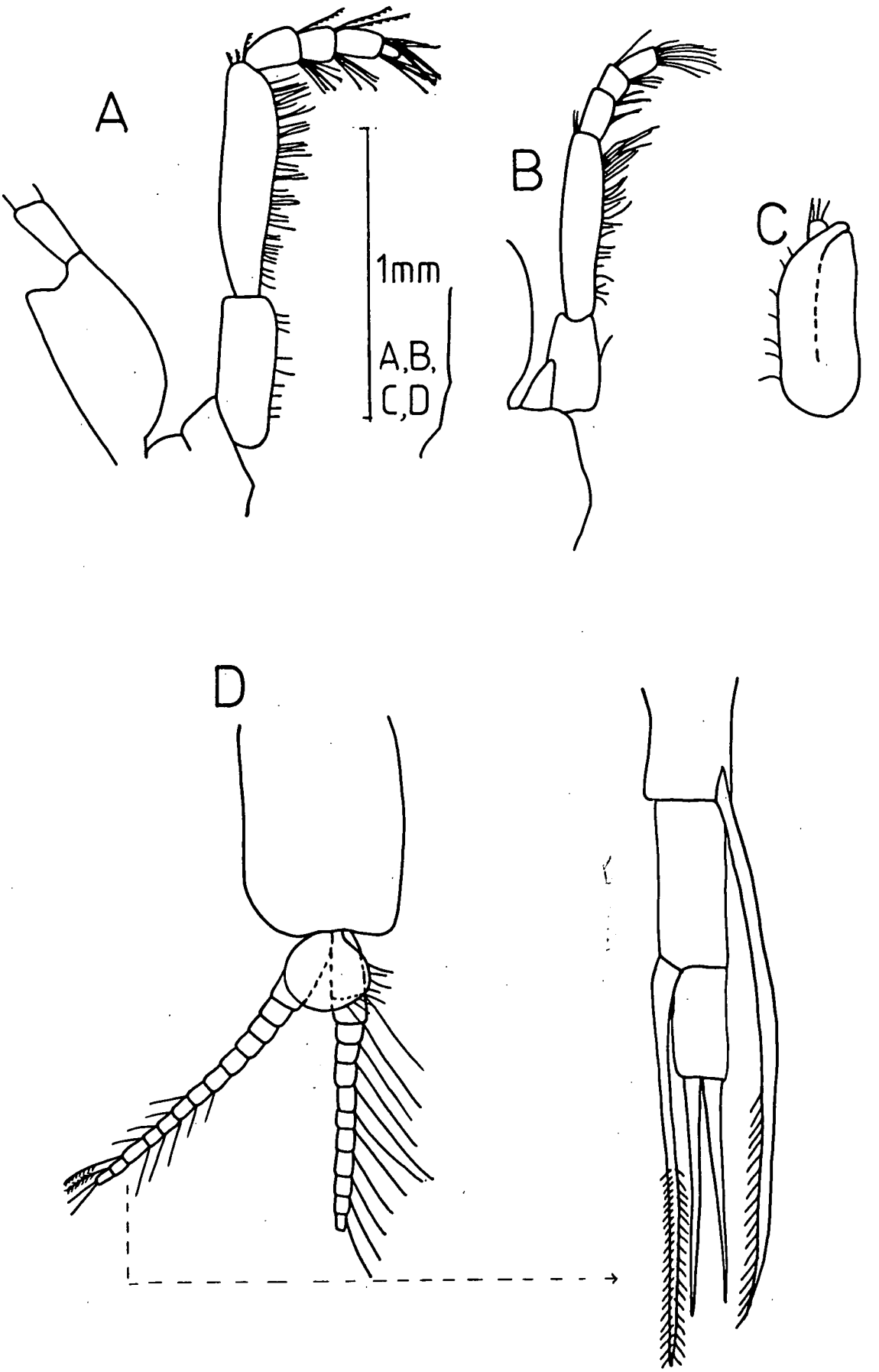

A
1mm
A,B,
C,D
B
C
D

Fig. 2.28 *Allomysis sp.1* n.g. n.sp.

A Telson.

B Ventral surface of telson.

C Uropods.

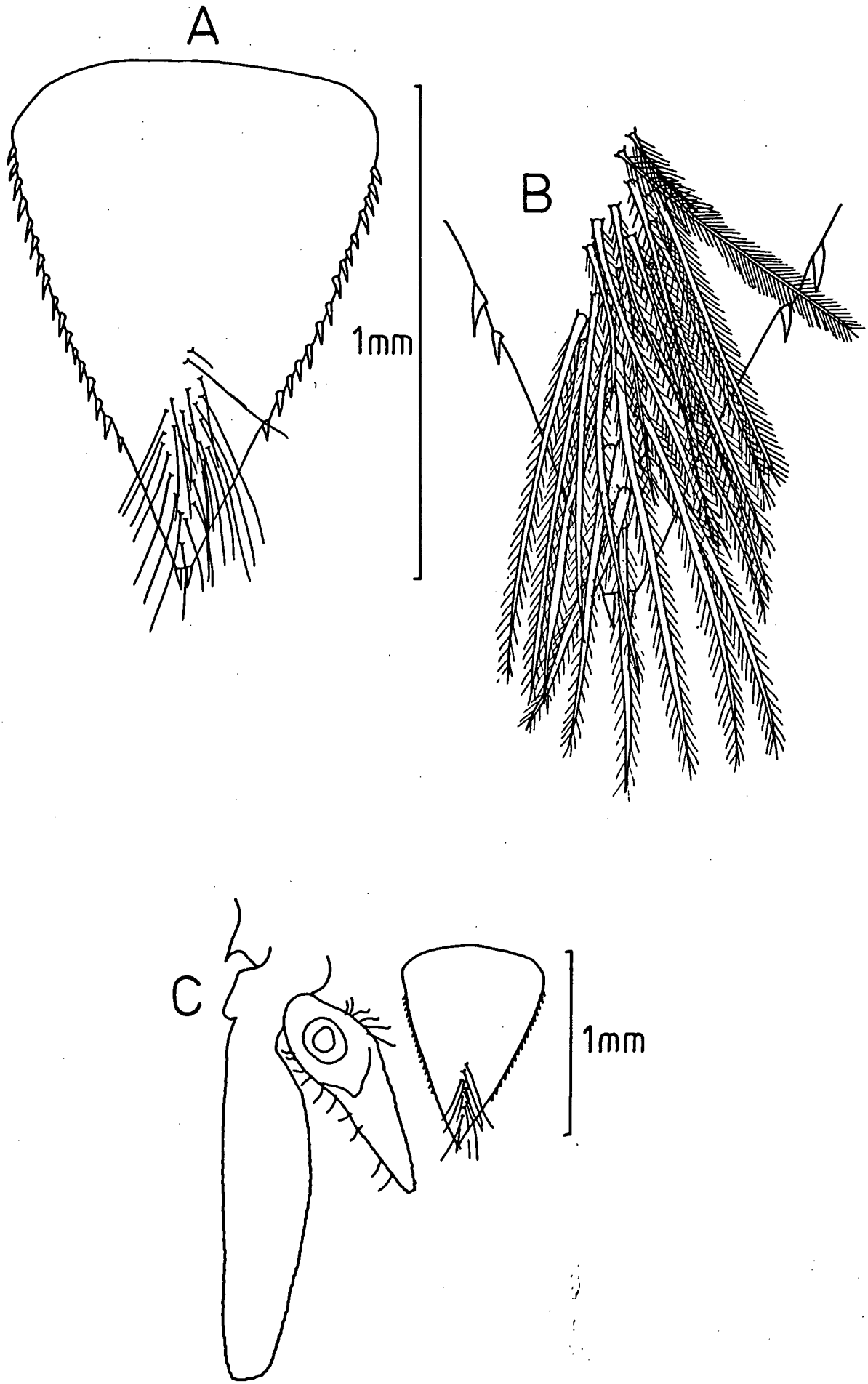

A
1mm
B
C
1mm

Table 2.4 Size of dorsal fin in Allomysis sp.1 n.g. n.sp.

STAGE	BODY LENGTH (mm)	HEIGHT OF FIN (mm)
juvenile	6.0	0.3
♀ immature	8.7	0.4
♀ immature	9.8	0.6
♀ immature	10.0	0.6
♀ immature	10.7	0.5
♀ mature	12.2	0.7
♂ immature	7.9	0.1
♂ mature	9.9	0.2
♂ mature	12.8	0.3
♂ mature	13.1	0.3

ii) Genus Australomysis Tattersall, 1927

Diagnosis. Antennal scale lanceolate; lateral and medial borders setose. Small distal articulation. Mandible with well-developed molar process. Propodus of third to eighth thoracic endopods with one or two articulations. Telson cleft; cleft armed with spines but no plumose setae. Inner margin of endopod of uropod with a row of spines. Male pleopods as in the genus Leptomysis. Exopod of fourth pair longer than endopod; modified setae present on last three segments. Female brood pouch formed by 3 pairs of lamellae (W.M. Tattersall, 1927).

Remarks. The genus is known only from Australia and two species have been described, A.incisa and A.acuta, both in Tattersall (1927).

Key to the Australian Species of Australomysis

1. Eyes dorso-ventrally flattened (Fig. 2.29A). Lateral margins of the telson with hiatus (Fig. 2.29B). Propodus with two transverse articulations. ..... A.incisa

--- Eyes spherical, elongated eyestalks. Lateral margins of telson without hiatus. Carpus and propodus separated by an oblique articulation. 2

2. Rostrum with prominent serrated margins (Fig. 2.30A). Endopod of uropod with row of 57 spines on inner margin (Fig. 2.30F). Lateral borders of telson with 26 spines. .....A.sp.1 n.sp.

--- Rostrum acute, margins unarmed (Fig. 2.29C). Endopod of uropod with row of 22 spines on inner margin (Fig. 2.29D). Lateral borders of telson with 18 spines. ..... A.acuta

Australomysis acuta W.M. Tattersall, 1927

Diagnosis. W.M. Tattersall, 1927.

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1927): South Australia, Gulf of St. Vincent.
2) National Museum of Victoria Bass Strait Survey: Stations 53, 107,111, 166 and 207.
3) South Australian Museum Collection: Near Pt. Pirie and Outer Harbour.
4) Tasmania: Partridge Island; Blow-hole and Fortescue Bay, Tasman Peninsula; Margate Beach; One Tree Point, Bruny Island.

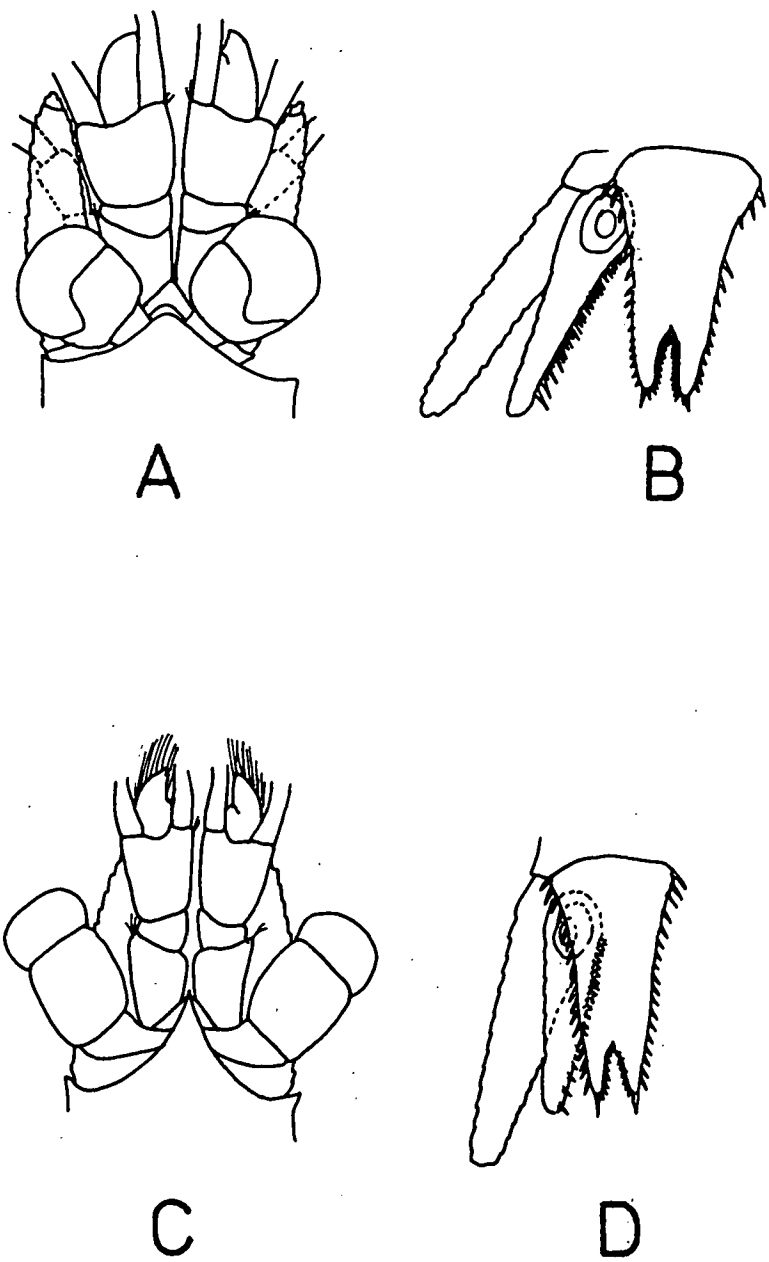


Fig. 2.29 Genus Australomysis

A A.incisa dorsal view of anterior end of male.

B A.incisa telson and uropods (38 diam).
(Figs. A & B after Tattersall, 1927 Figs. 101a & b respectively).

C A.acuta dorsal view of anterior end of male (39 diam).

D A.acuta telson and uropod (39 diam).
(Figs. C & D after Tattersall, 1927 Figs. 102a & Fig. 103a respectively).

A.incisa (G.O. Sars, 1883)

Diagnosis. W.M. Tattersall, 1927.

Known Distribution. Australia.

Australian Records.

1) G.O. Sars (1885): Victoria, Port Phillip Bay.
2) W.M. Tattersall (1927): South Australia, Vivonne Bay, south coast of Kangaroo Island.
3) Dakin and Colefax (1940): New South Wales, Broken Bay.
4) South Australian Museum Collection: South Australia, Thistle Island.
5) National Museum of Victoria Bass Strait Survey: Stations 48, 107, 108, 110, 111, 115, 118, 119, 120, 121, 184, 194 and 208.
6) Bacescu and Udrescu (1982): Tenagomysis aseta is probably A.incisa. Examination of the types which are in very poor condition was carried out but species identification was not possible. However, the species is not a Tenagomysis species and Bacescu is in agreement with the transfer of this species to the genus Australomysis (pers. comm.); this is discussed later.
6) Tasmania: Moorina Bay surf beach, Bruny Island.

Australomysis sp.1 n.sp.

Material examined. HOLOTYPE: Mature male 8.2mm in length, Tasmanian Museum, registration number G2798. PARATYPES: 5 females and 5 males are lodged both at the Tasmanian Museum and the Australian Museum, registration numbers G2799 and P3477 respectively. All material was collected in 20m water at Bicheno by Dr. G. Edgar on 9-4-84.

Diagnosis. Holotype male, 8.2mm and female paratype where appropriate. Carapace short, exposing last 3 thoracic segments. Anterior margin produced into a large triangular rostrum armed with numerous large teeth, extending forwards to second segment of antennular peduncle. Large sub-rostral process present. Male rostrum bears a longer terminal spine. Antero-lateral edges bear a prominent spine (Figs. 2.30A & B). Eyes approximately twice as long as broad; spherical, pigment black. Antennal scale twice as long as peduncle in female and approximately 1.25 times as long in male; setose along lateral and medial edges; small terminal joint. Antennular peduncle of male slightly larger than in female; terminal lobe in male bearing usual brush of setae. Terminal segment of maxilla bears approximately 12 spines and 4 plumose setae (Fig. 2.30C). Carpus and propodus of third to eighth thoracic legs separated by an oblique articulation. Nail with short spine on inner margin as in A.acuta (Fig. 2.30D). Telson cleft: approximately 26 spines border lateral edges; 21 spines line each side of cleft. Each apical

Fig. 2.30 *Australomysis sp.1* n.sp.

A Anterior of adult female, dorsal view.

B Anterior margin of carapace, dorsal view.

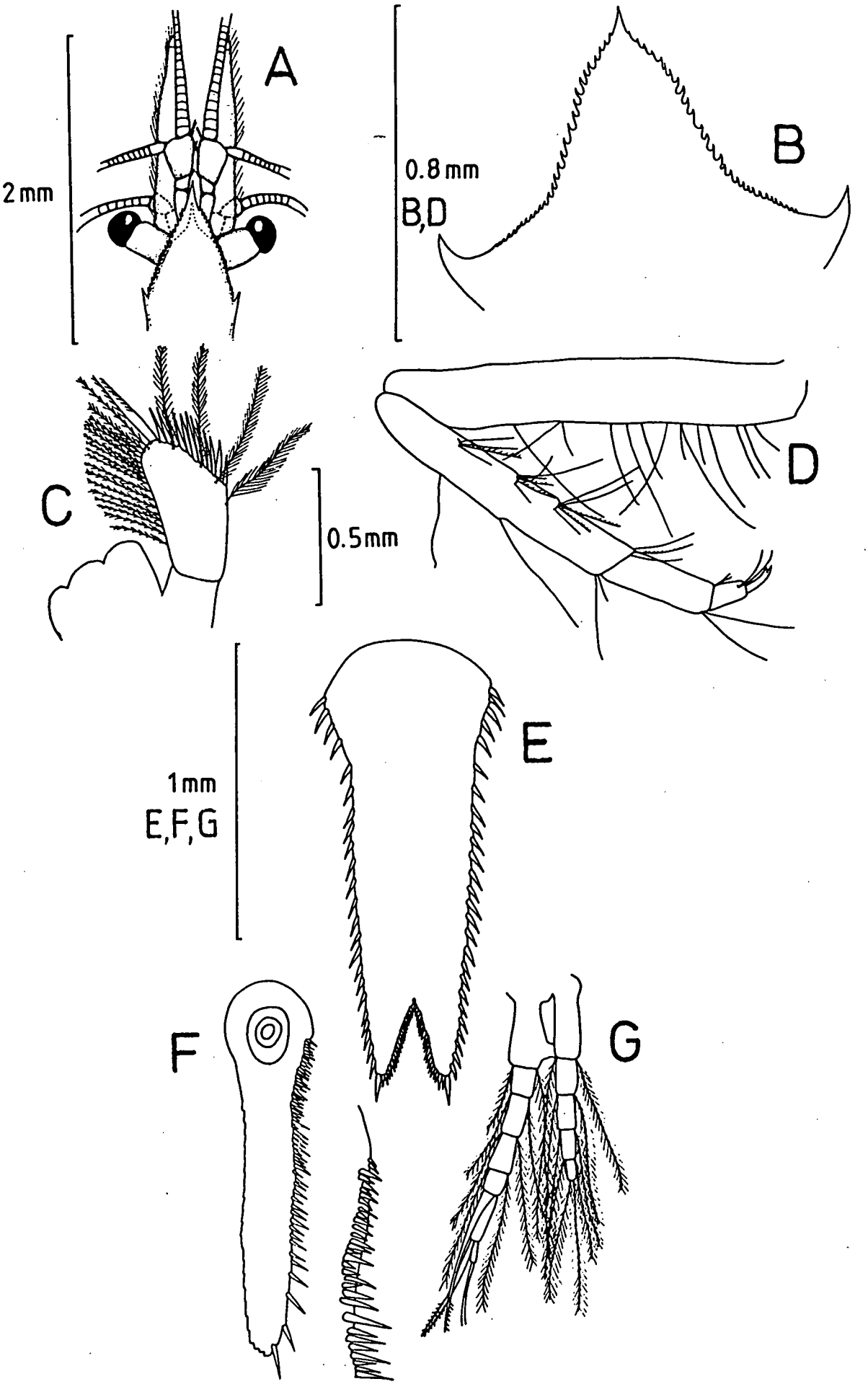
C Maxilla, terminal endopod.

D Third thoracic leg.

E Telson.

F Endopod of uropod.

G Male pleopod 4.


A
2 mm
B
0.8 mm
B,D
C
0.5 mm
D
1 mm
E,F,G
E
F
G

lobe bears one large spine (Fig. 2.30E). Uropods: endopod only slightly longer than telson; approximately 57 spines, both small and large, line inner margin extending from statocyst to apex (Fig. 2.30F). Both exopod and endopod bear setae along lateral and medial edges. Pleopods of the male: as in A.acuta. Exopod of pleopod 4 composed of 7 segments; antepenultimate and penultimate segments both bear a strong seta; terminal segment with two simple setae (Fig. 2.30G). Female brood pouch formed by 3 pairs of lamellae.

Pigmentation: dark red-crimson in life, fading when preserved.

Adult body length: 8.0-10.5mm, measured from the tip of the rostrum to the end of the exopod of the uropods.

Remarks. Australomysis sp.1 n.sp. appears to be most closely related to A.acuta, based on the shape of the eyes, armature of the telson and articulation of the thoracic legs. The two species differ in that A.sp.1 n.sp. has serrations on the rostrum together with a greater number of spines on the lateral margins of the telson and inner margin of the endopod of the uropods.

It is of interest to note that both A.incisa and A.acuta have been collected from the coastal waters of southern Tasmania (pers. obs.).

Known Distribution. Australia.

Australian Records.

1) Tasmania: Known only from the type locality, where it was observed on blades of seagrass Zostera muelleri in 20m of water (G. Edgar, pers. comm.).

iii) Genus Doxomysis Hansen, 1912

Diagnosis. Eyes normally developed. Antennal scale short and slender; setose along lateral and medial borders. Labrum obtuse in front; no spiniform process. Mandibles with well-developed molar surface. Maxilla with distal segment of palp broader than long; endites and exopod setiferous and well-developed. Carpo-propodus of third to eighth thoracic endopods divided into 3 sub-segments, proximal articulation sometimes oblique. Male pleopods well-developed, biramous. Exopod of fourth pleopod elongated; antepenultimate and penultimate segments with a long seta; terminal segment with 1 or 2 simple setae. Telson cleft at apex. Apical lobes with several large spines, cleft armed with spines and a pair of plumose setae. Inner margin of endopod of uropod armed with a row of spines. Female brood pouch formed by 2 pairs of lamellae (Ii, 1964).

Remarks. Mauchline (1980) lists 8 species currently belonging to the genus:

D.anomala Tattersall, 1922, D.australiensis (Tattersall, 1940), D.hanseni Colosi, 1920, D.littoralis Tattersall, 1922, D.longiura Pillai, 1963, D.microps Colosi, 1920, D.quadrispinosa Illig, 1906 and D.zimmeri Colosi, 1920. Two recent additions, D.rinkaiensis Valbonesi and Murano, 1980 and D.proxima Bacescu and Udrescu, 1982 bring the number of species known to ten. However it must be stated that the specific status of D.hanseni, D.microps and D.zimmeri is unclear. There has been considerable discussion in the literature as to whether they are merely synonymous with the species D.quadrispinosa (Tattersall, 1922, 1951; Illig, 1930; Ii, 1964; Pillai, 1973).

The first record of the genus Doxomysis from Australian waters was from the Great Barrier Reef when Tattersall (1936a) recorded D.littoralis. Interestingly some of the specimens were smooth and others minutely spinulose. He concluded that the spinules must rub off easily. This discrepancy was discussed by Pillai (1973). His feelings were that Tattersall had probably caught a mixture of D.littoralis and the hispid species D.longiura, since after examining a number of damaged individuals of D.longiura he found the spinules were persistent. Tattersall (1940) described a species, Afromysis australiensis from the New South Wales coast, which was later placed in the genus Doxomysis by Nouvel in 1966. In 1982, Bacescu and Udrescu added more details to the description of D.australiensis from a population from the Brisbane Coast and also described a new species from Moreton Bay, D.proxima. Pillai (1973) recorded D.quadrispinosa from the north-west coast of Western Australia during an extensive study of the mysids of the Indian Ocean.

The new species described here, Doxomysis sp.1 n.sp., represents the first record of the genus from Tasmanian waters.

Key to the Australian Species of Doxomysis

1. Lateral margins of telson with spines only on distal half (Fig. 2.31A). .....D.quadrispinosa
--- Lateral margins of telson with spines along entire length. 2

2. Body surface hispid. Lateral margins of telson with wide gap between first two pairs of spines (Fig. 2.31B). ..... D.longiura
--- Body surface smooth. Lateral margins of telson without hiatus between first two pairs of spines. 3

3. Apical lobes of telson with 11 spines; 7 large and many small spines line cleft (Fig. 2.32F). ..... D.sp.1 n.sp.

Fig. 2.31 Genus Doxomysis

A Doxomysis quadrispinosa telson and uropod.
(After Pillai, 1973 Fig. 57A; no scale provided).

B D.longiura posterior part of body showing telson and hispid body surface.
(After Pillai, 1973 Fig. 58B; no scale provided).

C D.australiensis telson.
(After W.M. Tattersall, 1940 Fig. 6c).

D D.australiensis fourth male pleopod.

E D.australiensis maxilla.
(Figs. C & D after Bacescu and Udrescu, 1982 Fig. 5F & B respectively).

F D.littoralis telson x95.

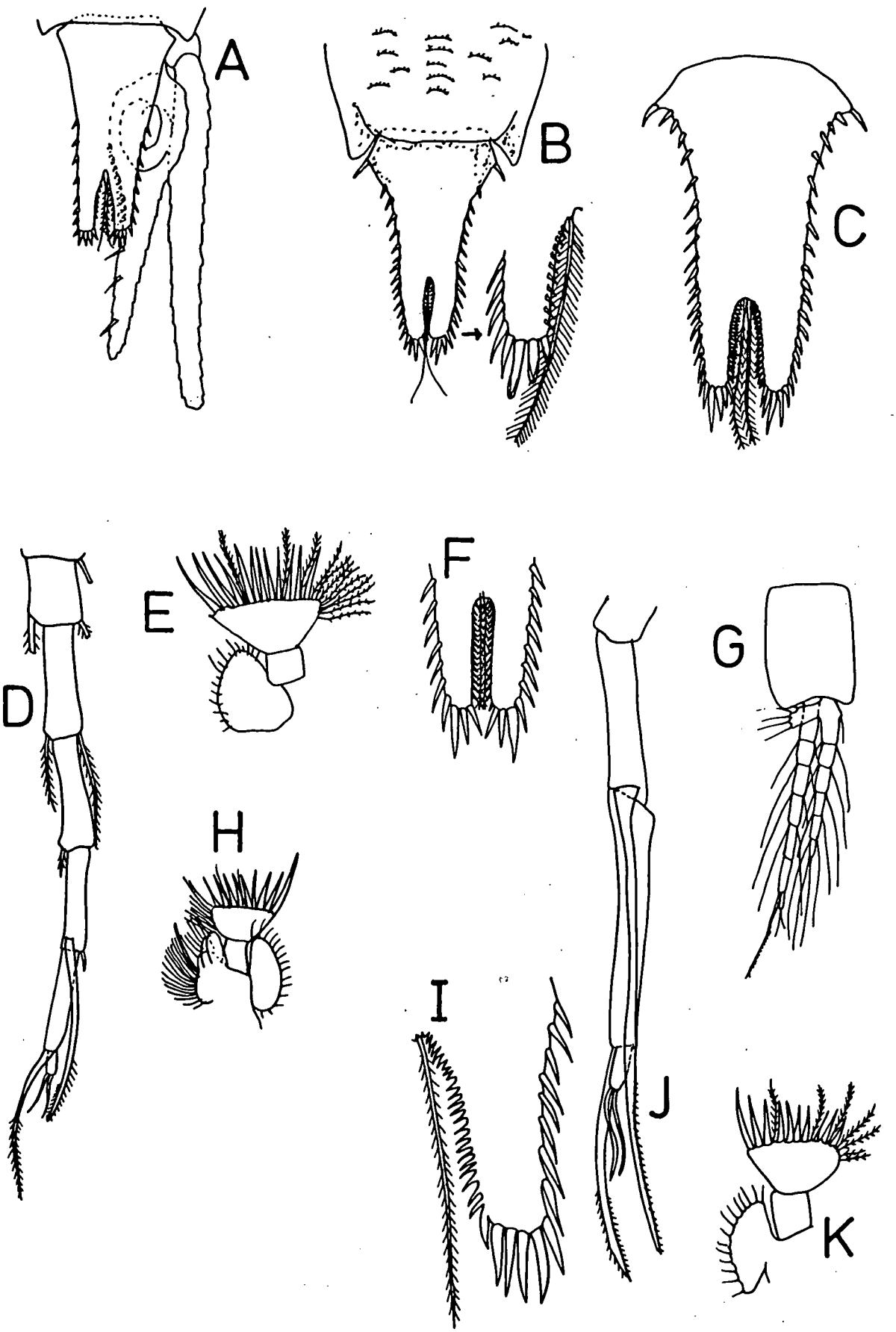
G D.littoralis fourth male pleopod x60.

H D.littoralis maxilla x60.
(Figs. E, F & G after Ii, 1964 Fig. 97K, H & E respectively).

I D.proxima telson.

J D.proxima fourth male pleopod.

K D.proxima maxilla.
(Figs. H, I & J after Bacescu and Udrescu, 1982 Fig. 5M, K & J respectively).


A
B
C
D
E
F
G
H
I
J
K

--- Apical lobes of telson with 3-4 spines; small spines line cleft. 4

4. Apical lobes of telson with 4 spines (Fig. 2.31C). Penultimate segment of exopod of pleopod 4 approximately same length as antepenultimate segment (Fig. 2.31D). Maxilla with terminal segment of endopod broad (Fig. 2.31E). ..... D.australiensis

--- Apical lobes of telson with 3 spines. Penultimate segment of exopod of pleopod 4 either much shorter or much longer than antepenultimate segment. 5

5. Apical lobes of telson with 3 spines (Fig. 2.31E). Penultimate segment of exopod of pleopod 4 half-length of antepenultimate segment (Fig. 2.31G). Maxilla as in Fig. 2.31H. .... D.littoralis

--- Apical lobes of telson with 3 spines (Fig. 2.31I). Penultimate segment of exopod of pleopod 4 almost twice as long as antepenultimate segment (Fig. 2.31J). Maxilla as in Fig. 2.31K. .... D.proxima

Doxomysis australiensis W.M. (Tattersall, 1940)

Diagnosis. W.M. Tattersall, 1940; Bacescu and Udrescu, 1982.

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1940): New South Wales, Broken Bay.
2) Dakin and Colefax (1940): New South Wales, Broken Bay.
3) Bacescu and Udrescu (1982): Queensland, Middle Banks and Toorbul Point, Moreton Bay in 140m of water on muddy bottom.

D.littoralis W.M. Tattersall, 1922

Diagnosis. W.M. Tattersall, 1922; Ii, 1964.

Known Distribution. 30°N-15°S littoral (Mauchline and Murano, 1977); Andaman Islands (W.M. Tattersall, 1922); north-west of Carimata Strait, Dutch East Indies (Ii, 1964).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef east of Low Isles and at Low Isles Anchorage. NB. Mixture of smooth and spinulose specimens; the smooth = D.littoralis and the spinulose = D.longiura.
2) Pillai (1973): West coast of Australia, Station 219 1J.
3) Australian Museum Collection: Great Barrier Reef, Lizard and Heron Islands.

D.longiura Pillai, 1963

Diagnosis. Pillai, 1963, 1964 and 1973.

Known Distribution. 11°N-7°N (Mauchline and Murano, 1977); Kerala Coast, Arabian Sea (Pillai, 1973).

Australian Records.

1) Pillai (1973): suggested that W.M. Tattersall (1936a) had caught a mixture of D.littoralis and D.longiura depending on whether the specimens had a smooth or spinulose body respectively. Tattersall (1936a) thought that the spines had rubbed off some of his specimens, but Pillai (1973) found that even quite badly damaged specimens of D.longiura clearly remained spinulose.

D.proxima Bacescu and Udrescu, 1982

Diagnosis. Bacescu and Udrescu, 1982.

Known Distribution. Australia.

Australian Records.

1) Bacescu and Udrescu (1982): Queensland, Moreton Bay.

D.quadrispinosa (Illig, 1906)

Diagnosis. Pillai, 1973.

Known Distribution. 20°N-6°S epipelagic (Mauchline and Murano, 1977); widely distributed in the tropical waters of the Indian and Pacific Oceans (W.M. Tattersall, 1951; Pillai, 1973).

Australian Records.

1) Pillai (1973): West coast of Australia, Station 748.

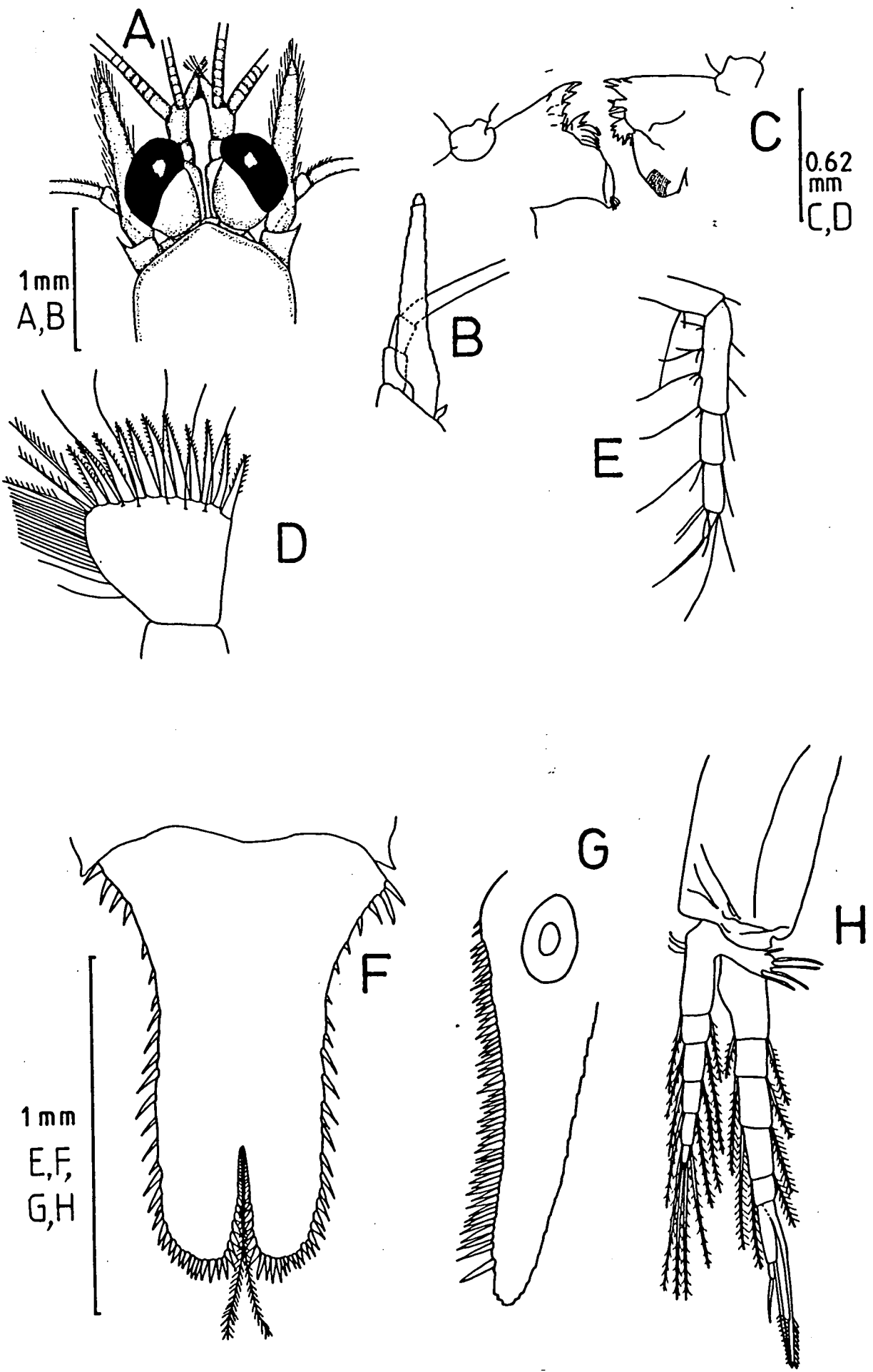
D.sp.1 n.sp.

Material examined. HOLOTYPE: Mature male 9.2 mm in length, Tasmanian Museum registration number G2800. PARATYPES: 4 females and 3 males, Tasmanian Museum G2801 and Australian Museum P34772. All material collected 20-6-83 in 2-4m of water at Tinderbox by Dominic O'Brien.

Diagnosis. Carapace short leaving last two thoracic segments exposed; antero-lateral edges rounded; produced in front into a short rostrum (Fig. 2.32A). Eyes large, cornea occupies approximately half eyestalk in dorsal view; pigment black. Antennular peduncle 2/3 length of antennal scale; first segment almost twice as long as last segment; male appendage moderate in size bearing a brush of setae. Antennal scale approximately 6 times as long as broad; setose all round with small terminal joint (Fig. 2.32B). Mouthparts: labrum rounded, no spiniform process present. Mandibles with well-developed masticatory surface (Fig. 2.32C). Maxilla

Fig. 2.32 Doxomysis sp.1 n.sp.

A Anterior of adult male, dorsal view.
B Antennal scale.
C Mandibles.
D Maxilla, terminal endopod.
E Third thoracic leg.
F Telson.
G Endopod of uropod.
H Male pleopod 4.


A
1mm
A,B
B
C
0.62
mm
C,D
D
E
F
1mm
E,F,
G,H
G
H

bears 11-14 barbed spines and 5 elongated setae at distal end of terminal endopod (Fig. 2.32D). Carpo-propodus of third to eighth thoracic legs subdivided into 3 segments (Fig. 2.32E). Telson slightly longer than 6th abdominal segment; lateral edges armed with spines; 11-13 spines arm each apical lobe, 6-7 large spines extend into cleft. Remainder of cleft armed with small spines; two long plumose setae arise from base of cleft (Fig. 2.32F). Uropods: endopod 1.5 times length of telson; inner edge bears a row of spines extending from statocyst nearly to apex; setose along lateral and medial borders (Fig. 2.32G). Exopod approximately twice length of telson; setose along lateral and medial borders. Pleopods of male: first pair uniramous, pairs 2-5 biramous. Pleopod 4 modified and elongated; 6-segmented endopod and 7-segmented exopod. Antepenultimate segment of exopod bears a strong seta or flagellum, penultimate segment with similar but smaller seta, terminal segment with 2 simple setae (Fig. 2.32H).
Pigmentation: slightly orange in life, fading when preserved leaving dark areas on the ventral surface.
Adult length: 8-11mm, measured from the tip of the rostrum to the end of the exopod of the uropods.
Remarks. D.sp.1 n.sp. is easily distinguished from the other species known to belong to the genus Doxomysis. The telson of D.sp.1 n.sp. differs from all other species in the presence of several large spines in the apical cleft and the presence of numerous spines arming each apical lobe. In addition to this characteristic telson, the distal border of the terminal segment of the maxilla bears barbed spines, a condition not observed in the other Doxomysis species. The segmentation of the thoracic legs and male pleopods of D.sp.1 n.sp. is similar to that of D.australiensis.
Known Distribution. Australia.
Australian Records.
1) Tasmania: Tinderbox; Tasman Bay; Partridge Island; Blow-hole, Tasman Peninsula; Recherche Bay; Taroona Beach; Tin Pot Point; One Tree Point Bruny Island and Fortescue Bay. It is known from the shallow coastal waters of southern Tasmania, where it is found forming swarms in approximately 2-4m of water.

iv) **Genus** Iimysis Nouvel, 1966

Diagnosis. Labrum with prominent forwardly directed spine. Terminal segment of maxilla longer than broad. Carpo-propodus of thoracic endopods 3-8 with 3 segments. Distal segment of mandibular palp elongate. Telson cleft: lateral margin of cleft armed with spines; base of cleft with a pair of

plumose setae.

Remarks. There are currently two species in the genus Iimysis, viz, I.orientalis and I.atlantica. Both were transferred from the genus Tenagomysis by Nouvel in 1966. The species described here is the first representative of the genus from the Southern Hemisphere.

Iimysis sp.1 n.sp.

Material examined. HOLOTYPE: 5.8mm male collected from One Tree Point, 12-4-1983. PARATYPES: 5 females and 5 males collected from One Tree Point, from 12-4-1983 to 13-4-1983.

Diagnosis. General body form slender. Carapace short exposing last 3 thoracic segments; produced in front into a broadly triangular rostrum not quite covering base of eyestalks; antero-lateral margins rounded (Fig. 2.33A). Eyes slightly elongated, cornea occupies 1/3 of eyestalk in dorsal view; pigment black. Antennal scale slightly longer than antennular peduncle; approximately 7 times as long as broad; terminal articulation absent (Fig. 2.33B). Antennular peduncle with male hirsute lobe almost 1/2 as long as distal segment of peduncle. Labrum with spiniform process (Fig. 2.33C). Mandible with well-developed molar process (Fig. 2.33D); palp with median segment slender; distal segment approximately 1/2 length of median segment (Fig. 2.33E). Maxilla with terminal segment of endopod with 6 strong, barbed spines on distal margin together with 3 plumose setae; antero-lateral margin with 10-11 strong plumose setae; endites and exopod setiferous (Fig. 2.33F & 2.34A). Endopods of thoracic legs 3-8 with carpopropodus composed of 3 segments separated by transverse articulations (Fig. 2.34B). First male pleopod uniramous, pairs 2-5 biramous. Exopod of fourth pair composed of 7 segments, antepenultimate and penultimate segments with single long strong seta (Figs. 2.34C & D); terminal segment with 2 simple setae; endopod composed of 6 segments. Telson sub-triangular, nearly twice as long as its basal width; apical cleft occupies 1/5 of telson length; 10 spines arm each side of cleft; pair of plumose setae at base of cleft. Lateral margins with 11-16 spines, 1 large spine on each apical lobe (Fig. 2.34E). Uropods: endopod slightly longer than telson; 19-24 spines arm inner margin extending from statocyst nearly to apex (Fig. 2.34F). Exopod 1/3 longer than endopod (Fig. 2.34G). Both endopod and exopod setose along lateral and medial borders.

Adult length: 6-6.5mm, measured from the tip of the rostrum to the distal end of the exopod of the uropod.

Remarks. Iimysis sp.1 n.sp. can be distinguished from I.atlantica and I.orientalis by several features including the telson, inner margin of the

Fig. 2.33 Iimysis sp.1 n.sp.

A Anterior of adult female.

B Antennule and antenna.

C Labrum.

D Mandible.

E Mandibular palp.

F Maxilla.

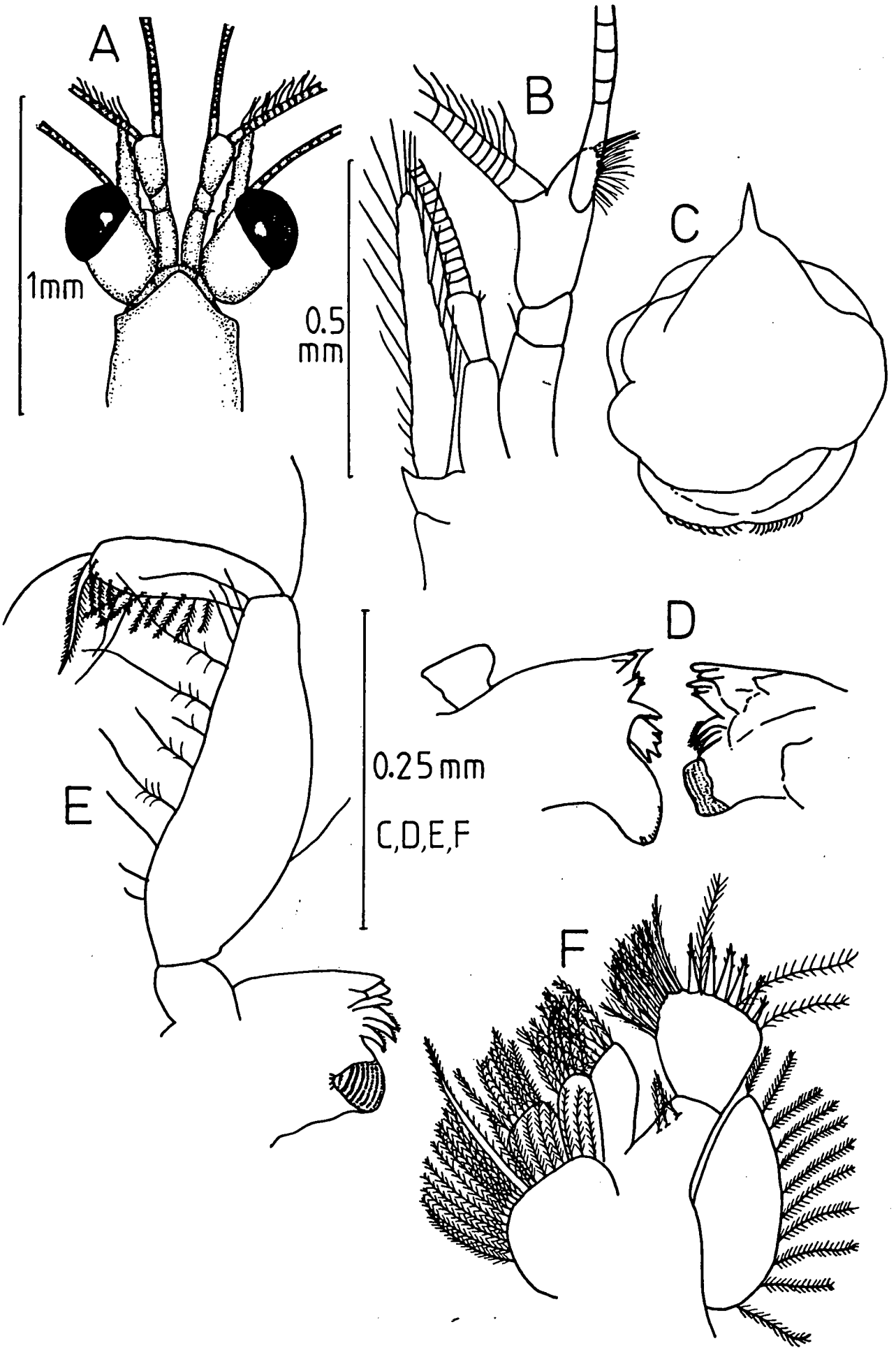
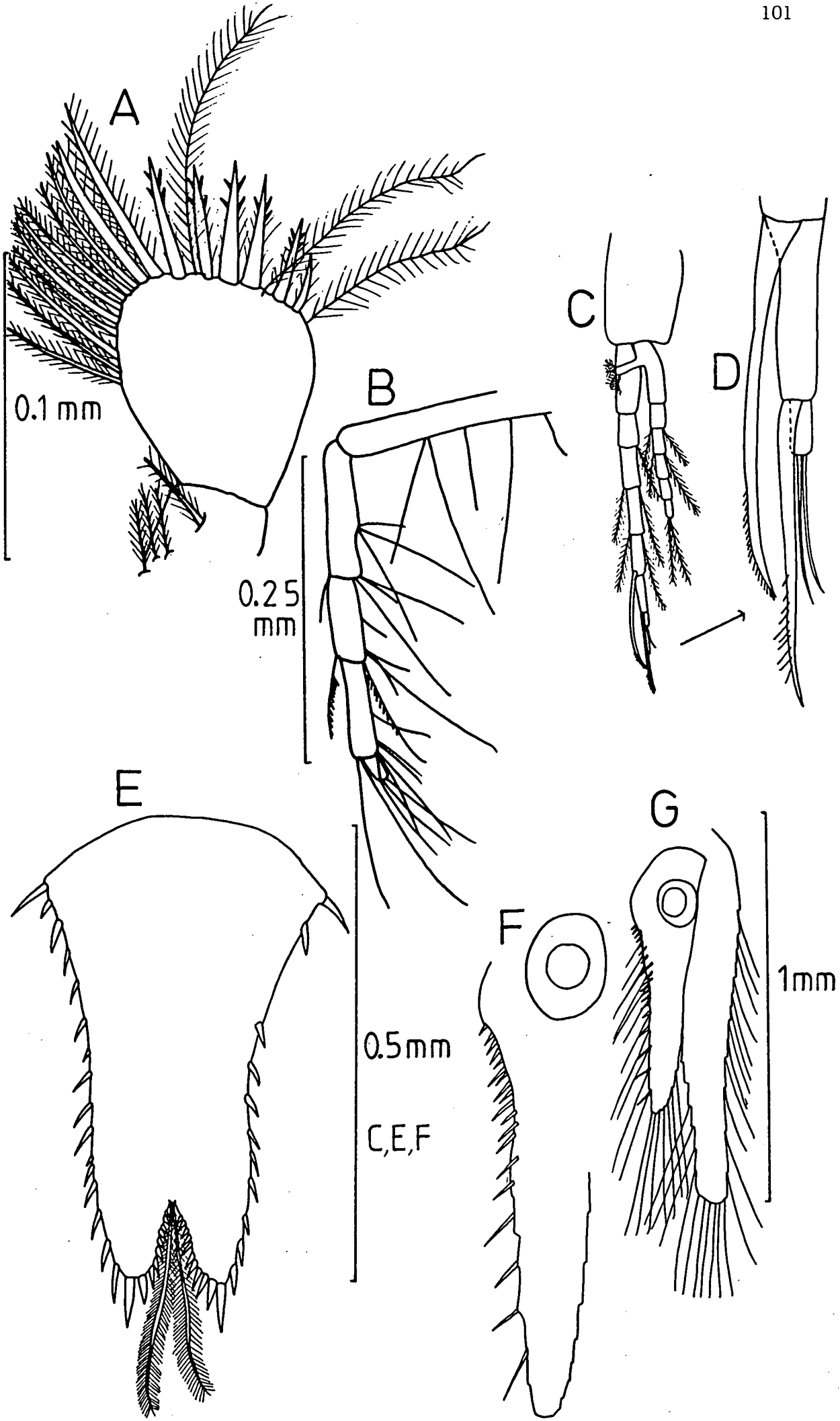

A
1mm
B
0.5
mm
C
D
E
0.25mm
C,D,E,F
F

Fig. 2.34 Iimysis sp.1 n.sp.

A Terminal segment of maxilla.
B Endopod of 6th thoracic leg.
C Male pleopod 4.
D Distal portion of 4th male pleopod.
E Telson.
F Endopod of uropod.
G Uropods.


A
0.1 mm
B
0.25 mm
C
D
E
0.5mm
C,E,F
F
G
1mm

endopod of uropod and maxilla. The telson of both I.atlantica and I.orientalis is considerably more than twice as long as its basal width; the telson of I.sp.1 n.sp. is not quite twice as long as broad. The cleft of I.orientalis is armed with 26-40 small spines (Ii, 1964) compared to 10 in I.sp.1 n.sp. A row of spines line the inner margin of the endopod of uropod in all three species; however, this row is composed of 40 spines in I.atlantica, 70 in I.orientalis and only 19-24 in I.sp.1 n.sp. The maxilla of I.sp.1 n.sp. bears 6 barbed spines along the distal margin of the terminal segment. In I.orientalis and I.atlantica the number of spines present are 11 and 7 respectively (Ii, 1964; Nouvel, 1942); however, barbed spines have not been reported for these species.

Known Distribution. Australia.

Australian Records.

1) Tasmania: Known only from the type locality; One Tree Point, Bruny Island.

v) **Genus** Leptomysis G.O. Sars, 1869

Diagnosis. Rostrum triangular and acute. Antennal scale with 2 segments, subulate, lateral and medial borders setose; sympod with or without spines. Eyes well-developed, globular; strong, triangular eyestalk extends beyond lateral margins of body. First thoracic endopod with segments 2 and 3 separate and distinct. Carpo-propodus of thoracic endopods 3-8 sub-divided into 3 segments; dactylus small, slender nail. Pleopods of female rudimentary; first male pleopod with endopod unsegmented, pleopods 2-5 biramous well-developed; exopod of pleopod 4 with long modified setae on 3 distal segments. Uropods: inner margin of endopod with row of closely packed spines usually extending from statocyst to apex. Telson entire, linguiform; lateral margins armed with numerous spines, often arranged in series of 2-3 small spines between larger spines distally. Female with 3 pairs of brood lamellae.

Remarks. Eleven species are known (Mauchline, 1980); only one, L.australiensis, is known from Australia. It should be noted here that Karl Wittmann (pers. comm.) proposes removing L.australiensis from the genus Leptomysis and erecting a new genus to accept it; provisionally known as Notomysis. For this reason a species diagnosis has not been provided as the description given by W.M. Tattersall (1927) contains several significant errors. However, the following characters are diagnostic (Karl Wittmann, pers. comm.): presence of a "drop-like" organ on the antennular peduncle of the male, unique to this species; the presence of plumose setae on the

ventral surface of the telson similar to those found in Allomysis n.g.; structure of the mandible with reduced molar process; telson with small apical incision. This combination of features suggests affinities with the genera Promysis, Prionomysis and Mysidopsis rather than Leptomysis (Wittmann, pers. comm.).

L.australiensis W.M. Tattersall, 1927

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1927): South Australia, Gulf of St. Vincent.
2) Dakin and Colefax (1940): New South Wales, "specimens of a new species near to L.australiensis were taken off Broken Bay." Attempts to locate the material of Dakin and Colefax have been unsuccessful.
3) National Museum of Victoria Bass Strait Survey: Stations 108, 111, 119, 166 and 184.
4) South Australian Museum: South Australia, Silt grounds, between Reevsby and Partney Islands and Edithburgh Jetty.
5) Tasmania: Partridge Island; Southerly Bight; Blow-hole, Tasman Peninsula; One Tree Point, Bruny Island.

vi) **Genus Mysidetes** Holt and Tattersall, 1906

Diagnosis. Rostrum short. Antennal scale lanceolate; lateral and medial borders setose; small distal articulation. Eyes large, globular; eyestalk short. Endopod of first thoracic limb composed of 7 segments; second segment with well-developed lobe, nail long and slender. Second thoracic endopod usually with well marked lobe on second segment; dactylus usually armed with closely set row of strong barbed setae. Thoracic endopods 3-8 with 3-segmented carpo-propodus; dactylus small, nail long and slender. Male genital appendage from base of 8th thoracic limb, long, tubular and curved towards anterior end of body. Pleopods in both sexes reduced to simple unsegmented plates which increase in length progressively posteriorly. Endopod of uropod with row of spines extending from statocyst to apex. Telson cleft armed with small spines but no setae; apical lobes usually rounded (Tattersall and Tattersall, 1951).

Remarks. Fourteen species are known (Mauchline, 1980). Only one species is known from Australian waters, viz, M.halope (O'Brien in press).

M.halope O'Brien, in press

Diagnosis. O'Brien (in press).

Known Distribution. Australia.

Australian Records.

1) O'Brien (in press): Marine cave dwelling mysid in south-eastern Tasmania.

vii) Genus Prionomysis Tattersall, 1922

Diagnosis. Antennal scale long and narrow; setose along medial and lateral borders; terminal segment distinct. Maxilla with terminal segment of palp longer than broad, without strong spines on its distal margin; setiferous endite from second segment small; exopod small and narrow. Carpo-propodus of third to eighth thoracic endopods composed of 3 segments formed by transverse articulations. Female brood pouch formed by 3 pairs of lamellae. Male pleopods as in the genus Leptomysis G.O. Sars. Exopod of fourth pair longer than endopod; antepenultimate and penultimate segments bear a stout seta; terminal segment with 1-2 simple setae. Telson linguiform in shape; apex cleft with a pair of plumose setae at the base but without spines. Lateral borders of telson armed throughout with spines. Endopod of uropods with a row of small spines along inner margin (Ii, 1964).

Remarks. Only two species are currently known to belong to the genus Prionomysis: an Indian species P.stenolepis, which has also been collected from the Great Barrier Reef (unpubl. data, Aust. Mus.), and P.aspera known from the coastal waters of Japan. The new species described here, Prionomysis sp.1, represents the first record of the genus from Tasmania.

Key to the Australian Species of Prionomysis

1. Telson linguiform narrowing distinctly at 3/4 of the length (Fig. 2.35A); exopod of fourth male pleopod composed of 9 segments (Fig. 2.35B). ..... P.stenolepis

--- Telson with only slight narrowing (Fig. 2.37E); exopod of fourth male pleopod composed of 12 segments (Fig. 2.37D). .... P.sp.1 n.sp.

Prionomysis sp.1 n.sp.

Material examined. HOLOTYPE: Male 10.5mm, Tasmanian Museum registration number G2802. PARATYPES: 5 females and 5 males, Tasmanian Museum G2803 and the Australian Museum P34770. The specimens of P.sp.1 n.sp. were collected

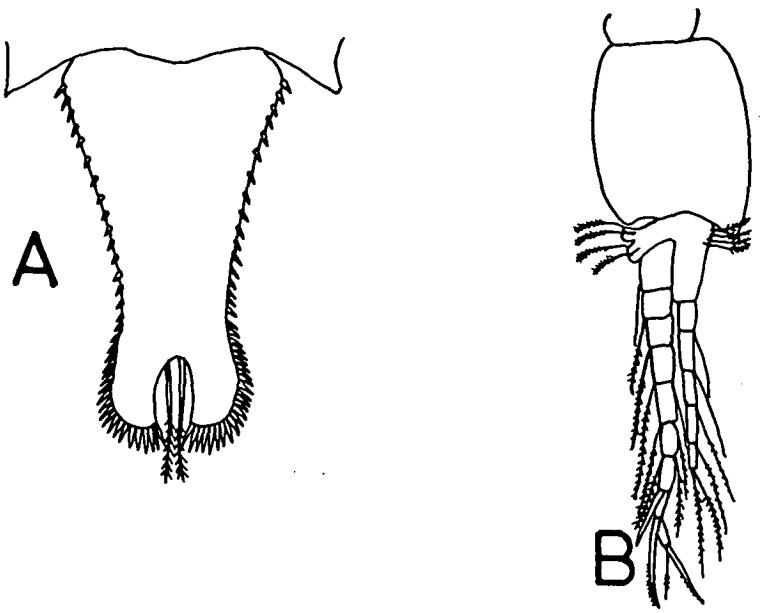


Fig. 2.35 Prionomysis stenolepsis

A Telson x60 (After Tattersall, 1922 Fig. 16j).

B Male pleopod 4; x60 (After Tattersall, 1922 Fig. 16h).

using a shallow dredge off a surf beach at Moorina Bay, Bruny Island, Tasmania on the 30-6-81 by Ron Mawbey and Richard Holmes.

Diagnosis. Carapace short exposing last two thoracic segments; antero-lateral edges rounded; produced in front into an acutely pointed rostrum (Fig. 2.36A). Eyes markedly elongated, cornea occupies approximately 1/3 eyestalk in dorsal view; pigment black. Antennal scale elongate, 12 times as long as broad; distal articulation (Fig. 2.36B). Antennular peduncle with modified seta at median segment (Fig. 2.36C). Molar process of mandibles rudimentary bearing only a small tuft of setae (Fig. 2.36D); mandibular palp slender and elongated. Maxilla without spines; exopod normal (Fig. 2.36E). Maxillule normal (Fig. 2.36F). First thoracic endopod with distinct ischium; endites absent (Fig. 2.37A). Second thoracic endopod normal (Fig. 2.37B). Carpo-propodus of thoracic endopods 3-8 sub-divided into 3 segments (Fig. 2.37C). First male pleopod uniramous; pairs 2-5 biramous. Fourth pleopod of the male with exopod longer than endopod. Endopod composed of 7 segments; exopod composed of 10 segments. A strong spinose seta or flagellum arises from antepenultimate and penultimate segments; ultimate segment terminated by 2 simple setae (Fig. 2.37D). Telson cleft bearing a pair of plumose setae but without spines. Apical lobes of telson armed with numerous spines; lateral borders armed with spines throughout (Fig. 2.37E). Uropods: endopod 3/5 length of exopod; prominent acute spine arises on dorsal surface of outer posterior margin of statocyst; inner margin armed with a row of more than 35 bluntly pointed spines, extending from statocyst nearly to apex. Spines gradually increasing in length towards the apex (Fig. 2.37F). Both endopod and exopod setose along lateral and medial borders. Body form slender and delicate. All appendages elongated and slender.

Adult length: 10.0-11.0mm, measured from the tip of the rostrum to the end of the exopod of the uropods.

Remarks. Prionomysis sp.1 is easily distinguished from the other species in this genus. The telson of P.sp.1 does not narrow to the extent of the other species; the antennal scale is considerably longer and the exopod of pleopod 4 is composed of more segments than in other members of the genus.

Another interesting feature of P.sp.1 is the lack of the molar process on the mandibles. This feature is not reported for either of the two known species of Prionomysis. Ii (1964) stated that the molar process of P.aspera is well-developed but no drawing was provided. However, no mention of the mandibles is present in the original description of the genus or the type species description of P.stenolepis by Tattersall (1922). Examination of P.stenolepis (Australian Museum P34339) revealed that the

Fig. 2.36 *Prionomysis* sp.1 n.sp.

A Anterior of female.

B Antennal scale.

C Antennular peduncle.

D Mandibles.

E Maxilla.

F Maxillule.

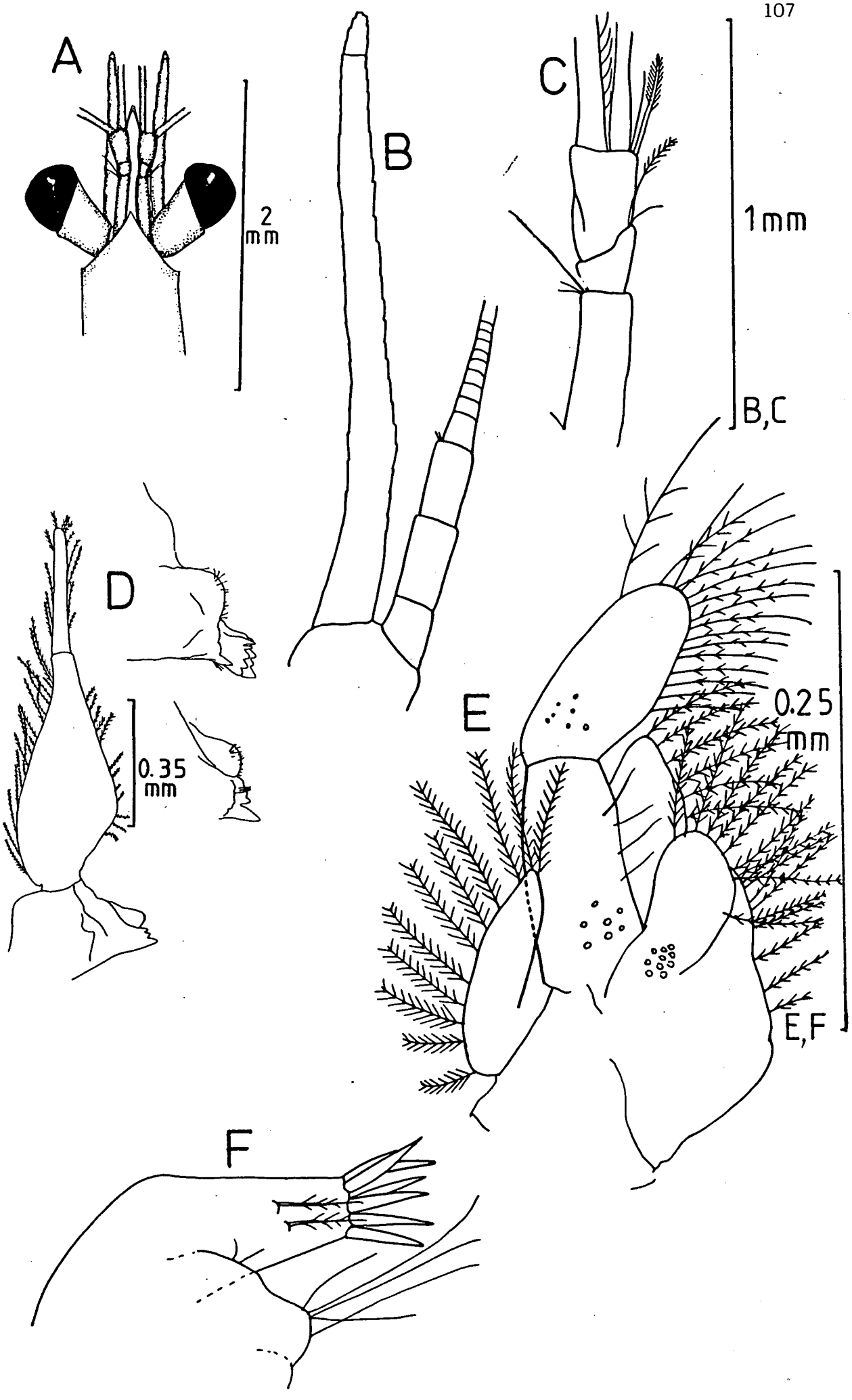
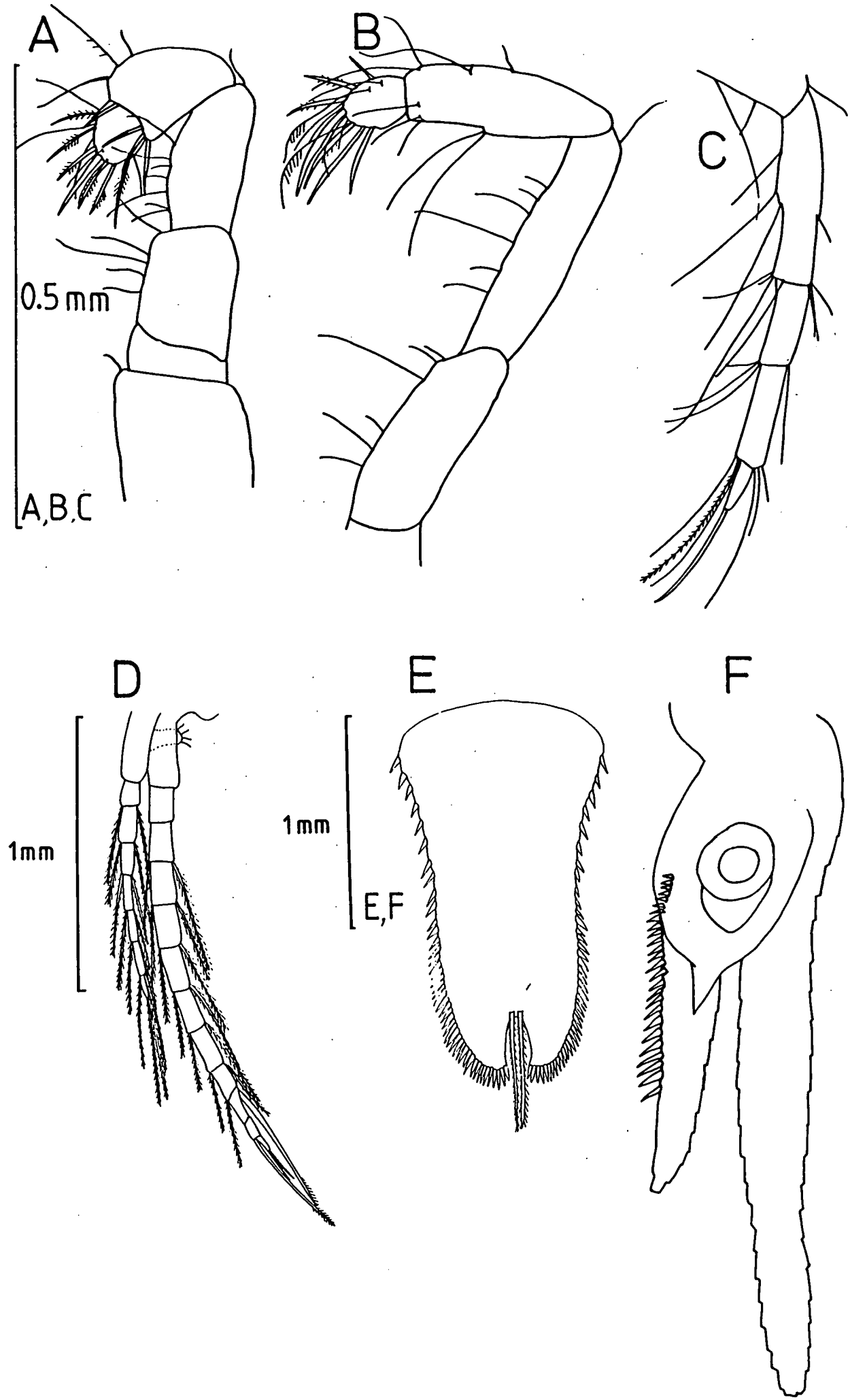

A
2 mm
B
C
1mm
B,C
D
0.35 mm
E
0.25 mm
E,F
F

Fig. 2.37 *Prionomysis sp.1* n.sp.

A First thoracic endopod.
B Second thoracic endopod.
C Fourth thoracic endopod.
D Male pleopod 4.
E Telson.
F Uropods.


A
B
C
0.5 mm
A,B,C
D
E
F
1mm
1mm
E,F

molar process is also under-developed as in P.sp.1 n.sp. This feature is also of interest when considered in relation to descriptions of the closely related genus Promysis, since the lack of a molar process has been used as a feature of Promysis species. However, it is perhaps insufficient for generic separation.

These two genera, Promysis and Prionomysis, although closely allied (Ii, 1964), are separated by 1) the armature of the telson: the apical lobes of Promysis are pointed and armed with one spine, whereas several spines arm the rounded apical lobes of Prionomysis; 2) the inner margin of the endopod of the uropod is armed by a row of small spines interspersed with several large curved spines in Promysis but only small spines in Prionomysis; and 3) the antennal scale of Promysis is shorter than the male appendage on the antennular peduncle, whereas in Prionomysis the scales are very long and narrow, at least twice the length of the antennular peduncle. Consequently, the new species should be placed in the genus Prionomysis (Murano pers. comm. agrees with this conclusion) and is probably most closely related to P.stenolepis. However, a revision of the genera Promysis, Uromysis and Prionomysis is necessary.

Known Distribution. Australia.

Australian Records.

1) Tasmania: Collected at Moorina Bay, Bruny Island and Hope Beach, South Arm.
2) National Museum of Victoria Bass Strait Survey: Station 212.

P.stenolepis Tattersall, 1922

Diagnosis. W.M. Tattersall, 1922.

Known Distribution. 12°N (Mauchline and Murano, 1977);
Andaman Islands, Indian Coast (W.M. Tattersall, 1922).

Australian Records.

1) Australian Museum Collection: Great Barrier Reef, Lagoon Lizard Island. NB. Lacks the long rostrum usual for P.stenolepis. Molar process underdeveloped.

viii) Genus Promysis Dana, 1850

Diagnosis. Eyes normally developed. Antennal scale short, lanceolate; lateral and medial borders setose; distal articulation. Labrum obtuse in front. Mandible without molar process. Maxilla similar to that of Prionomysis; setose expansion of second segment; exopod small. First and second thoracic limbs 3-8 slender; carpo-propodus sub-divided into 3 sub-segments.

Male pleopods typical of Tribe Leptomysini. Exopod of pleopod 4 elongated; both antepenultimate and penultimate segments with strong spinose seta, terminal segment with 2 simple setae. Telson cleft at apex; cleft without spines but with plumose setae; lateral margins of telson armed with small spines; apical lobes pointed. Uropods: inner margin of endopod with row of spines extending from statocyst to apex; some spines very large and prominent. Conical protuberance present on outer distal margin near statocyst (Ii, 1964).

Remarks. Two species are known in the genus (Mauchline, 1980), P.orientalis has been recorded from Australian waters. This genus, as already mentioned, closely related to the genus Prionomysis and is in need of revision.

Promysis orientalis Dana, 1852

Diagnosis. Eyes large, extend beyond second segments of antennular peduncle; with ocular papillae according to Pillai (1973), but without according to Ii (1964). Antennal scale narrowly lanceolate extends slightly beyond antennular peduncle but not beyond male appendage on antennular peduncle. Mandible without molar process. Telson with cleft occupying approximately 1/5 of total length; apical lobes very narrow distally (Fig. 2.7F). Lateral margins of telson armed with 15 short spines, cleft without spines but with pair of plumose setae. Uropods: endopod longer than telson but shorter than exopod; inner margin of endopod with row of spines; four spines on distal half very large and strong (Ii, 1964; Pillai, 1973).

Known Distribution. 34°N-10°S littoral, (Mauchline and Murano, 1977); South China Sea (Colosi, 1919 and 1920; Ii, 1964); East Indies, Pulu Tonkil, Sulu-Archipelago (Hansen, 1910); between Ceylon and New Guinea (Zimmer, 1915); Philippine Islands (W.M. Tattersall, 1951).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, east of Low Isles and Barrier Reef Lagoon.
2) Pillai (1973): West coast of Australia; Station 217.

ix) Genus Pseudomysidetes W.M. Tattersall, 1936a

Diagnosis. Carapace anteriorly broad, evenly rounded. Eyes large. Antennal scale broadly lanceolate; lateral and medial borders setose; distal articulation. Maxilla with terminal segment of palp strongly and unusually armed. First thoracic limb powerful, lobe from second segment unusually large; lobe from third segment barely present; lobe from fourth segment small but clearly developed; seventh segment short and expanded. Second thoracic limb

slender compared to first pair; second segment expanded; seventh segment terminated by 2 strong spines. Third to eighth thoracic endopods exhibit a progressive reduction in length. Second segment of all endopods large and broadly expanded as a plate. Male genital appendage on 8th thoracic limb very long, reaching level of mouthparts anteriorly. Pleopods of male reduced to simple plates as in female. Telson entire or with minute apical cleft; long narrowly lanceolate; shoulder distal to base may or may not be present (W.M. Tattersall, 1936a; Panampunnayil, 1977).

Remarks. Two species are known (Mauchline, 1980); one, the type species is known from Australia. The second species is known only from the Kerala Coast of India (Panampunnayil, 1977).

Pseudomysidetes russelli W.M. Tattersall, 1936a

Diagnosis. Antennular peduncle with prominent blunt spine on outer margin of first segment. Maxilla with terminal segment of palp strongly and unusually armed; proximal half of inner margin with approximately 15 short stout spines, distal margin with row of 5 large triangular serrate spines; single terminal spine simple; exopod small with 11-12 setae on outer margin. Carpo-propodus of third thoracic endopod composed of 5 segments; 4 segments in thoracic endopods 4-7 and 3 in 8th thoracic endopod. Thoracic endopods 3 and 4 with simple dactylus; dactylus absent from thoracic endopods 5, 6, 7 and 8. Telson entire, long, narrowly lanceolate with well-defined shoulder distal to base marked by blunt process on either side. Distal half of telson with 25 spines arming each lateral border; apex with 1 pair of long spines separated by pair of minute spinules. Endopod of uropod without spines on inner margin (W.M. Tattersall, 1936a).

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, Station 29 outside Trinity Opening.
2) National Museum of Victoria Bass Strait Survey: Station 53; species identification not certain due to slight damage to the single specimen captured.

x) Genus Tenagomysis Thomson, 1900

Diagnosis. Carapace short, exposing at least last thoracic segment. Antennal scale narrowly lanceolate, setose along lateral and medial borders; distal articulation. Labrum without spiniform process. Mandibles with well-developed masticatory surface. Terminal segment of maxilla longer than

broad, armed with strong spines along distal margin of endopod; setiferous endites and exopod. Carpo-propodus of thoracic endopods 3-8 sub-divided into 2-14 sub-segments. Exopod of pleopod 4 with modified setae. Telson triangular, with apical cleft armed with spines and a pair of plumose setae.

Remarks. The genus Tenagomysis has undergone a considerable amount of re-arranging since the type species T.novae-zealandiae was first described by Thomson in 1900. In 1918 W.M. Tattersall described T.tenuipes from the Auckland Islands. Tattersall (1923) described a further 7 species in the genus, viz, T.chiltoni, T.macropis, T.producta, T.robusta, T.scottia, T.similis and T.thompsoni, from the collections made during the "Terra Nova" expeditions. At this stage Tattersall redefined the genus and provided a key for the identification of the known species. Until Ii (1937) described a Japanese species, T.orientalis, the genus was only known from New Zealand waters. In 1942 Nouvel described T.atlantica from the Bay of Biscay. The latter two species were subsequently removed from the genus Tenagomysis and placed in a new genus, Iimysis by Nouvel in 1966.

In 1952 and 1957 respectively, O.S. Tattersall described two species from African waters, T.natalensis and T.nigeriensis. Bacescu (1975) added another African species, T.tanzaniana. But in 1973 Bacescu and Vasilescu removed T.natalensis, T.nigeriensis and Doxomysis valdiviae from their genera and placed them in a new genus Nouvelia. This genus was re-examined by Bacescu (1975), at which time he considered that T.similis, a New Zealand species, may also belong in the genus Nouvelia. In addition he reported that he regards Tenagomysis tanzaniana as a sub-genus Tenagomysis (Nouvelia) tanzaniana.

It is probably somewhat surprising that the genus Tenagomysis has never been recorded from Australian waters. Although W.M. Tattersall in Dakin and Colefax (1940), did mention a species, "possibly in the genus Tenagomysis"; unfortunately no description was ever published and attempts to locate this material have failed. However, in 1982, Bacescu and Udrescu described a species named T.aseta from Moreton Bay, Queensland, which they considered to be in the genus Tenagomysis. This species is rather an unusual addition to the genus Tenagomysis since it does not have plumose setae in the cleft of the telson, hence the species name. However, it seems that this species has been incorrectly placed in the genus Tenagomysis; it should have been placed in the genus Australomysis, which characteristically does not have plumose setae in the telson cleft. Examination of the holotype (Queensland Museum reg. no. W11248) confirms my opinion that this species does not belong in the genus Tenagomysis but should now be

placed in genus Australomysis. Bacescu (pers. comm.) is in agreement with this decision.

Consequently this is the first record of the genus Tenagomysis from the coast of Australia; three new species are described.

Key to the Australian Species of Tenagomysis

1. Carpo-propodus of thoracic endopods sub-divided into 5 segments. Antennal scale very long; 15 times as long as broad. .... T.sp.1 n.sp.
--- Carpo-propodus of thoracic endopods sub-divided into 3 segments. Antennal scale less than 10 times as long as broad. 2

2. Lateral margins of telson with spines on distal half elongated. Exopod of 4th male pleopod composed of 9 segments. Carpo-propodus of thoracic endopods divided by transverse articulations. ..... T.sp.3 n.sp.
--- Lateral margins of telson with spines of uniform size. Exopod of 4th male pleopod composed of 7 segments. Carpo-propodus of thoracic endopods divided by an oblique and transverse articulations. ..... T.sp.2 n.sp.

Tenagomysis sp.1 n.sp.

Material examined. HOLOTYPE: Male 12.3mm long, deposited at the Tasmanian Museum reg. no. G2806; collected at One Tree Point, Bruny Island, Tasmania in 3m of water, 15th November, 1982. PARATYPES: 5 females and 5 males are lodged at both the Tasmanian Museum, reg. no. G2807.

Diagnosis. Carapace short leaving last 2 thoracic segments exposed; produced in front into an acute rostrum extending almost to end of first segment of antennular peduncle; antero-lateral edges rounded (Fig. 2.38A). Eyes elongate extending to last segment of antennular peduncle (Fig. 2.38B). Cornea black. Antennal scale narrow, 15 times as long as broad; lateral and medial borders setose; twice as long as antennular peduncle (Fig. 2.38C). Labrum rounded, no spiniform process present. Mandibles with well-developed masticatory surface (Fig. 2.38D). Distal segment of maxilla bears approximately 15 strong barbed spines; setiferous endites and exopod normal (Fig. 2.38E). Carpo-propodus of third to eighth thoracic legs sub-divided into 5 segments (Fig. 2.39A). Telson sub-triangular in shape, twice as long as its basal width; deeply cleft, approximately 1/3 of total telson length

Fig. 2.38 *Tenagomysis sp.1* n.sp.

A Adult male, lateral view, 12.3mm in length.

B Adult female, anterior.

C Antennal scale.

D Mandibles.

E Maxilla.

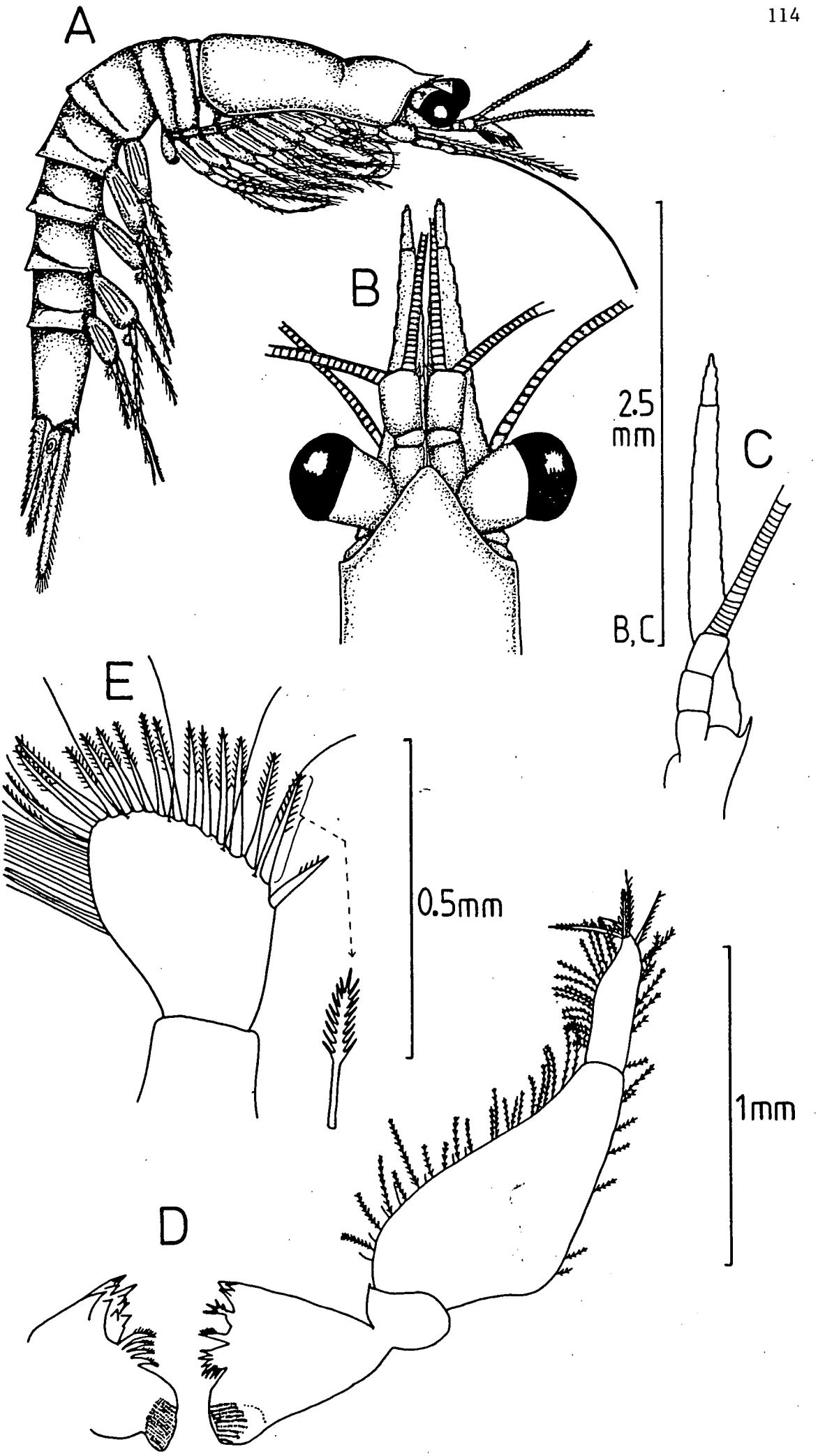

A
B
2.5
mm
B, C
C
E
0.5mm
1mm
D

Fig. 2.39 *Tenagomysis sp.1* n.sp.

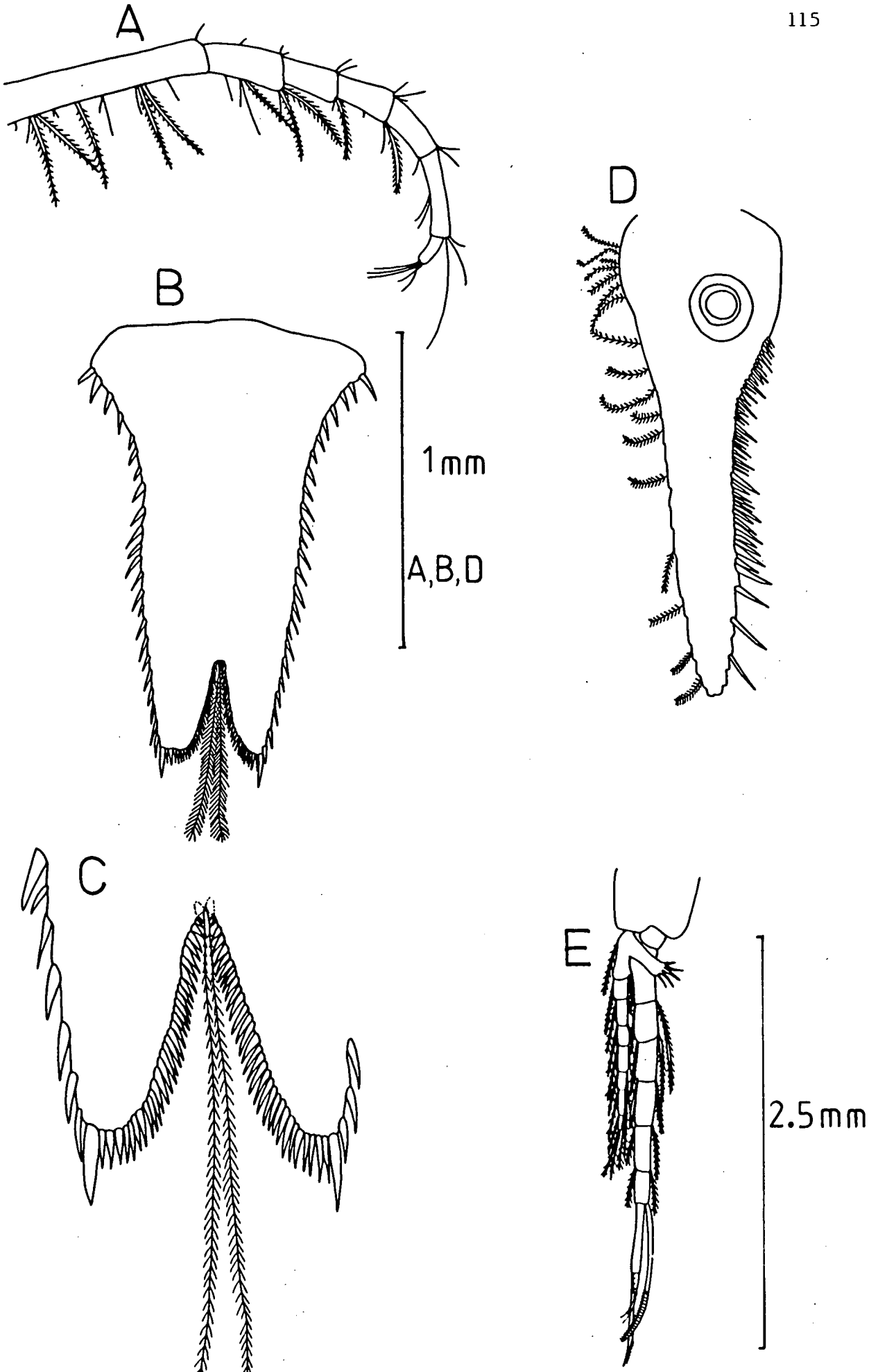
A Third thoracic leg.

B Telson.

C Apical cleft of telson.

D Endopod of uropod.

E Male pleopod 4.


A
B
1mm
A,B,D
D
C
E
2.5mm

(Fig. 2.39B). Lateral borders of telson with at least 20 spines; each apical lobe bears one large spine; cleft lined with approximately 30 spines and two long plumose setae originate at base of cleft (Fig. 2.39C). Uropods: endopod slightly longer than telson; stout spines border inner edge extending from statocyst nearly to apex (Fig. 2.39D). Exopod approximately 1.75 times as long as telson. Both endopod and exopod setose along lateral and medial borders. Male pleopods: 1st pair uniramous, pleopods 2-5 biramous. Pleopod 4 elongate, extending backwards to distal end of telson, exopod long and modified, composed of 8 segments; 6th segment bears a strong seta or flagellum, 7th segment has a similar but smaller seta; terminal segment bears 2 smaller curved setae at its apex (Fig. 2.39E). Female brood pouch formed by 3 pairs of lamellae.

Pigmentation of body: Dark brown - black in life, but fading in formalin leaving distinct pigmented areas between abdominal segments.

Body fairly robust. Adult length: 11-18mm, measured from the tip of the rostrum to the end of the exopod of the uropod.

Remarks. T.sp.1 n.sp. is distinguished from all other species in the genus by the long antennal scales. Only T.chiltoni and T.novae-zealandiae also have very long antennal scales (twice the length of the antennular peduncle). However, both these species have an acute spine on each antero-lateral margin of the carapace (Tattersall, 1923; Hodge, 1964), whereas in T.sp.1 n.sp. this margin is rounded. In addition, the carpo-propodus of the thoracic endopods is composed of 5 sub-segments in T.sp.1 n.sp. and only 3 and 4 in T.nova-zealandiae and T.chiltoni respectively. T.chiltoni is further distinguished by the presence of a prominent spine on the outer margin of the mandible beyond the base of the palp.

T.sp.3 n.sp. also has very long antennal scales; however, the armature of the telson, number of segments forming the thoracic endopods and exopod of pleopod 4 clearly distinguish the two species.

Known Distribution. Australia.

Australian Records.

1) Tasmania: One Tree Point, Bruny Island; Partridge Island; Southerly Bight; Fossil Island; Variety Bay; Granville Harbour; Hope Beach.
2) National Museum of Victoria Bass Strait Survey: Stations 107, 108, 111, 208 and 212.
3) South Australia Museum: South Australia, Outer Harbour.

T.sp.2 n.sp.

Material examined. HOLOTYPE: Male 9.3mm long, deposited at the Tasmanian Museum reg. no. G2808; collected at One Tree Point, Bruny Island, Tasmania

in 3m of water, November 1982. PARATYPES: 5 females and 5 males are lodged at both the Tasmanian Museum and at the Australian Museum, reg. no. G2809.

Diagnosis. Carapace short leaving last 3 thoracic segments exposed; front margin produced into a short acute rostrum (Fig. 2.40A). Eyes extending to first segment of antennular peduncle. Cornea black (Fig. 2.40B). Antennal scale approximately 5 times as long as broad, setose all round and only slightly longer than antennular peduncle (Fig. 2.40C). Labrum rounded, no spiniform process present. Mandibles with well-developed masticatory surface. Maxillule simple bearing 3 long setae on proximal endite amongst smaller setae. Maxilla most distinctive of mouthparts with approximately 10 large barbed spines at distal end of terminal endopod (Fig. 2.40D). Carpopropodus of thoracic endopods 3-8 sub-divided into 3 segments (Fig. 2.40E). Telson sub-triangular in shape, 1.5 times longer than its basal width, apical cleft approximately 1/6 of total telson length, more than 20 spines border lateral edges of telson and 4 spines arm each apical lobe (Fig. 2.41A). Each side of cleft is armed with 10 smaller spines; 2 plumose setae arise at base of cleft (Fig. 2.41B). Uropods: endopod longer than telson; 40 stout spines border inside edge, arranged in triplets extending from statocyst virtually to apex (Figs. 2.41C & D). Exopod nearly twice as long as telson. Both endopod and exopod setose along lateral and medial borders. Male pleopods: 1st pair uniramous with a 7-segmented exopod, pairs 2-5 biramous. Pleopod 4 elongate extending backwards to distal end of telson; exopod long composed of 7 segments, 5th segment bears a strong seta or flagellum, 6th segment bears a similar but smaller seta and 7th or terminal segment bears 2 simple setae (Fig. 2.41E). Female brood pouch formed by 3 pairs of lamellae.

Pigmentation of body: confined to small dots on ventral surface of abdomen, still present when preserved.

Adult length: 7-11 mm.

Remarks. T.sp.2 n.sp. is easily distinguished from other species in the genus by the presence of an oblique articulation separating the carpus from the propodus. However, T.sp.2 n.sp. is allied to T.novae-zealandiae, T.macropis, T.robusta and T.sp.3 n.sp. on the basis of the number of segments forming the carpo-propodus of the thoracic legs. Nevertheless, the presence of spines on the antero-lateral edges of the carapace of T.novae-zealandiae and T.macropis easily separate T.sp.2 n.sp. from these species. The robust body form and sub-equal length of the exopod and endopod of the uropod separate T.robusta from T.sp.2 n.sp. T.sp.3 n.sp. is distinguished from T.sp.2 n.sp. by the armature of the telson, size of antennal scales and segmentation of the fourth male pleopod.

Fig. 2.40 Tenagomysis sp.2 n.sp.

A Adult male, lateral view, 9.3mm in length.

B Adult male, anterior.

C Antennal scale.

D Maxilla.

E Third thoracic leg.

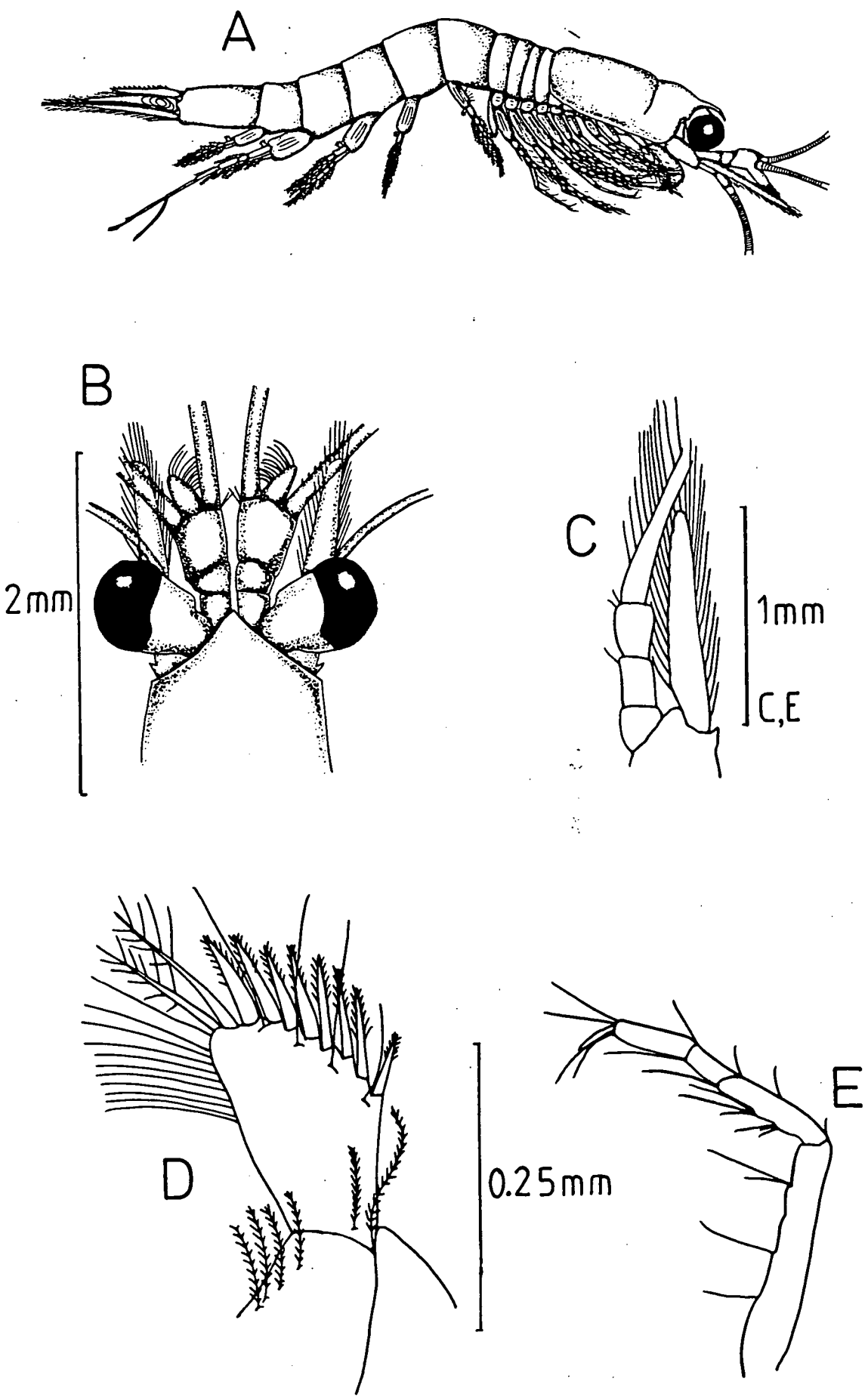

A
B
2mm
C
1mm
C,E
D
0.25mm
E

Fig. 2.41 *Tenagomysis sp.2* n.sp.

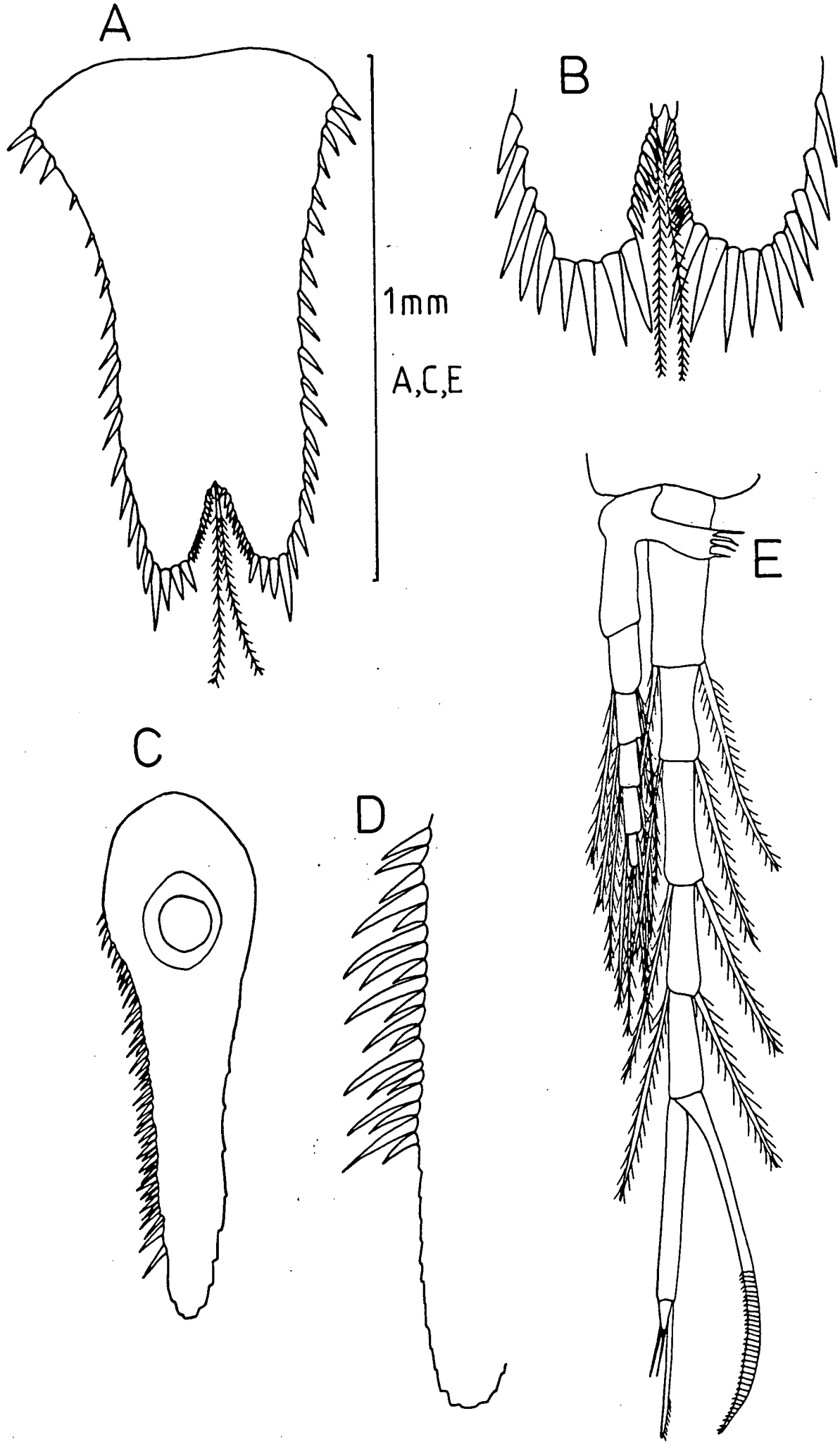
A Telson.

B Apical cleft of telson.

C Endopod of uropod.

D Arrangement of spines on endopod of uropod.

E Male pleopod 4.


A
B
1mm
A,C,E
E
C
D

Known Distribution. Australia.

Australian Records.

1) Tasmania: One Tree Point, Bruny Island; Partridge Island; Southerly Bight; Blow-hole, Tasman Peninsula; Schouten Island; Sandspit Pt.; Tin Pot Pt.; Hope Beach; Maatsuyker Island; Greenhead; Fortescue Bay.
2) National Museum of Victoria Bass Strait Survey: Stations 115, 135, 158, 164, 165, 166, 184 and 202.

T.sp.3 n.sp.

Material examined. HOLOTYPE: Male 9.6mm long, collected at Moorina Bay, Bruny Island, 30-6-1981. PARATYPES: 1 male and 1 female collected at Moorina Bay, Bruny Island, 30-6-1981, and 5 males and 2 females collected at Hope Beach, South Arm, 16-5-84.

Diagnosis. Carapace short exposing last thoracic segment; produced in front into an acute rostrum, extending approximately half length of antennular peduncle (Fig. 2.42A). Eyes slightly elongated, cornea occupies 1/3 of eye-stalk in dorsal view. Antennal scale approximately 10 times as long as broad; extending beyond antennular peduncle, almost twice as long as peduncle; small terminal joint. Male appendage bears a brush of setae extending length of peduncle to 2/3 that of antennal scale. Mouthparts: labrum rounded, no spiniform process present (Fig. 2.42B). Mandible with well-developed masticatory surface (Figs. 2.42C & D). Maxilla distinctive bearing 12 barbed spines and 5 elongated setae on distal end of terminal endopod (Fig. 2.42E). Carpo-propodus of thoracic endopods 3-8 sub-divided into 3 segments, dactylus terminating in a long slender nail (Figs. 2.43A & B). Male pleopods: 1st pair uniramous, pleopods 2-5 biramous. Pleopod 4 elongated, exopod composed of 9 segments, 7th segment bears a strong seta, 8th segment twice as long as 7th segment, bears a similar but smaller seta and 9th or terminal segment bears 2 simple setae; endopod composed of 8 segments. Exopod almost twice as long as endopod (Fig. 2.43C). Telson approximately same length as 6th abdominal segment; spines on lower half of lateral edges unusually long. Each apical lobe bears a large spine; small spines line cleft; two plumose setae arise from base of cleft (Fig. 2.43D). Uropods: exopod nearly twice length of telson. Endopod 3/4 length of exopod, approximately 40 stout spines border inside edge extending from near apex to statocyst. Exopod and endopod setose along lateral and medial borders (Fig. 2.43E).

Adult length: 9-11mm.

Remarks. T.sp.3 n.sp. is easily distinguished from all other members of the genus by the elongated spines present on the lateral margins of the telson.

Fig. 2.42 Tenagomysis sp.3 n.sp.

A Anterior of female.

B Labrum.

C Mandibles.

D Mandibular palp.

E Maxilla.

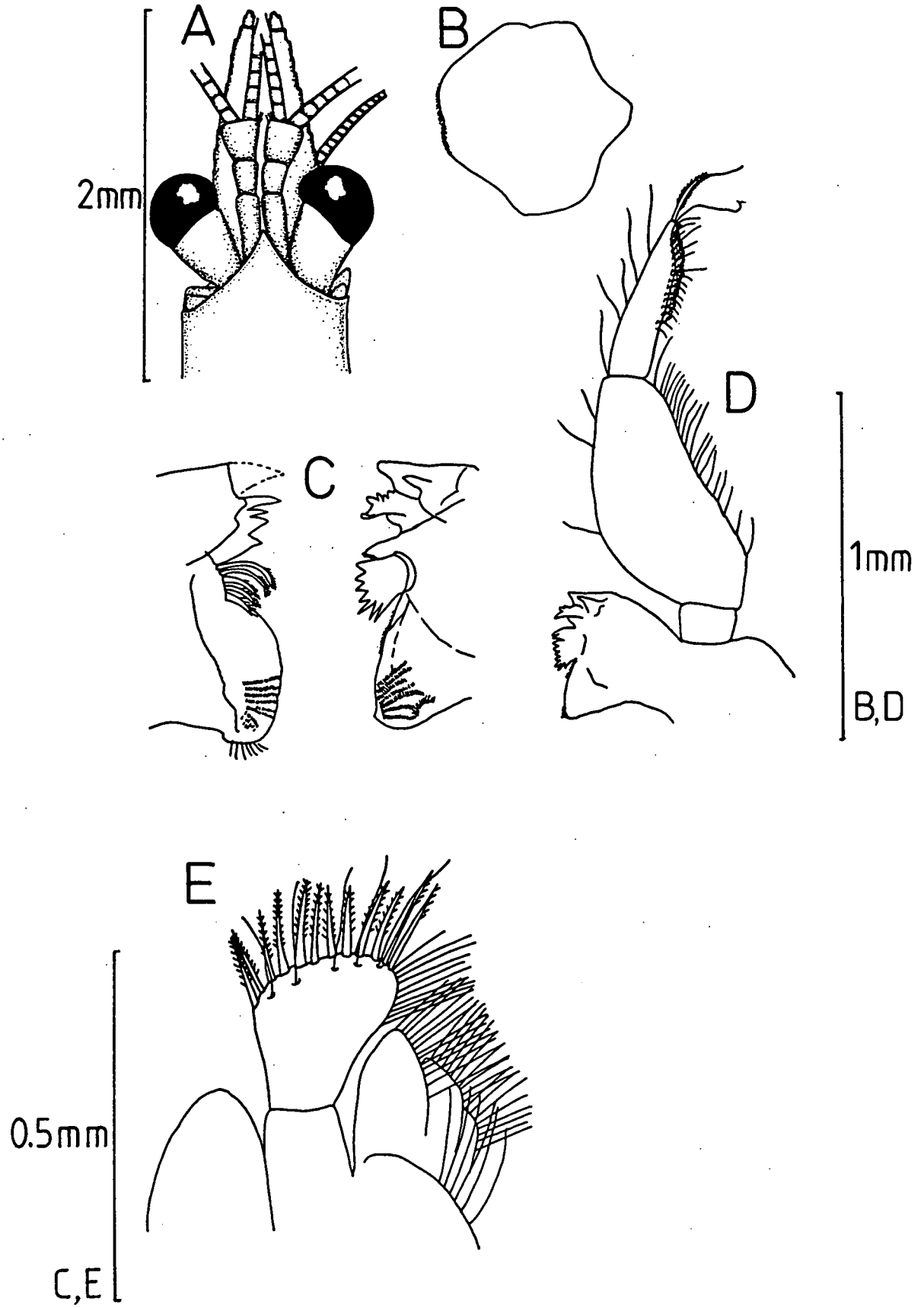
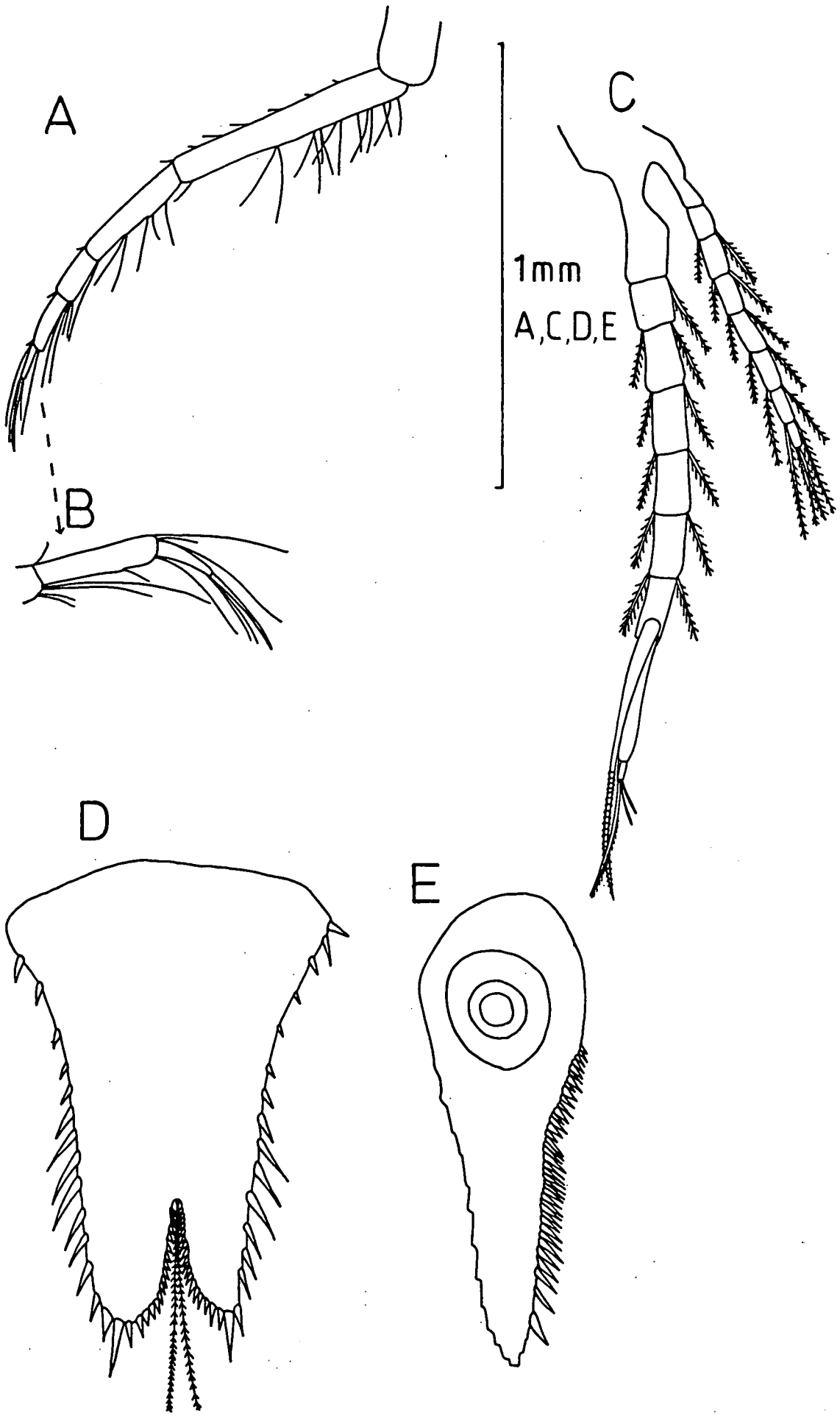

A
B
2mm
D
C
1mm
B,D
E
0.5mm
C,E

Fig. 2.43 Tenagomysis sp.3 n.sp.

A Third thoracic leg.
B Third thoracic leg, dactylus and nail
C Male pleopod 4.
D Telson.
E Endopod of uropod.


A
B
C
1mm
A,C,D,E
D
E

The long antennal scales and number of segments forming the carpo-propodus of the thoracic endopods are similar to those found in T.novae-zealandiae (Tattersall, 1923). However, the antero-lateral edges of the carapace of the latter species are produced into acute spines, whereas they are rounded in T.sp.3 n.sp. T.sp.1 n.sp. and T.sp.2 n.sp. are distinguished from T.sp.3 n.sp. for the reasons already discussed.

Known Distribution. Australia.

Australian Records.

1) Tasmania: Moorina Bay, Bruny Island; Hope Beach, South Arm.

C) Tribe Mysini

Diagnosis. Carpo-propodus of thoracic endopods 3-8 fused and sub-divided by transverse articulations into several sub-segments. First, second and usually fifth male pleopods rudimentary as in female; exopod of fourth pair always elongated distally with one or more modified setae. Antennal scale and telson very variable (Tattersall and Tattersall, 1951).

Remarks. Of the 32 genera known (Mauchline, 1980), two are known from Australian waters. Bacescu and Udrescu (1984) added a new genus, Halemysis known only from Australia, to the Tribe Mysini and two new genera are described here, bringing the total of genera represented to five. The form of the fourth male pleopod is the most reliable character for generic separation (Tattersall and Tattersall, 1951); other features vary widely within genera. It should be noted here that the separation of genera by the number of segments forming the fourth male pleopod has not led to an unreasonable number of monospecific genera; 11 of the 32 listed by Mauchline (1980) are monospecific However, many of the remaining genera are represented by numerous species.

i) Genus Anisomysis Hansen, 1910

Diagnosis. Body slender. Rostral projection sometimes present. Carapace short exposing last thoracic segment. Eyes large, sometimes divided into 2 parts. Antennal scale small, narrowly lanceolate, apex rounded; setose along lateral and medial borders; small distal articulation. Labrum obtuse in front. Mandibles with well-developed masticatory surface; palp with setae along inner margin of second segment (or with peculiar knob-like processes each bearing a tiny seta near the tip = flagellate tubercles: Paranisomysis sub.g.). Thoracic endopods 3-8 short, 1-segmented propodus. Female brood pouch formed by 2 pairs of lamellae. Male pleopods 1, 2, 3 and 5 rudimentary as small unsegmented plates. Pleopod 4 with small unsegmented

endopod; exopod elongated composed of 4 segments, first segment long, segments 2 and 3 sub-equal, penultimate segment with 1 long seta, terminal segment with 1 short seta. Telson short and very variable. Uropods slender; endopod without spines on inner margin (Ii, 1964; Bacescu, 1973a).

Remarks. A total of 23 species are known (Pillai, 1973; Mauchline, 1980; Panampunnayil, 1984); all are confined to the Indo-West Pacific Ocean. Of these, nine species have been recorded from Australian waters.

Key to the Australian Species of Anisomysis

1. Telson without cleft. 2
--- Telson cleft, or at least with distinct median emargination. 5

2. Cornea of eye divided into two parts. 3
--- Eyes normal. 4

3. Body surface smooth (Fig. 2.44A). Telson with slight median constriction; lateral margins armed with spines throughout; apex distally rounded (Fig. 2.44B). ..... A.bipartoculata
--- Body surface hispid (Fig. 2.44C). Telson with distinct median constriction; lateral margins unarmed between constriction and apex; apex distally rounded (Fig. 2.44D). ..... A.hispida

4. Telson triangular, apex narrow with 2 large spines (Fig. 2.44E & F). Mandibular palp without flagellate tubercles. ..... A.mixta australis
--- Telson with conspicuous constriction (Fig. 2.45A). Second segment of mandibular palp with 13 flagellate tubercles along inner margin. Sub.g. Paranisomysis. ..... A.lamellicauda

5. Cleft of telson or apical emargination armed with spines. 6
--- Cleft of telson unarmed. 8

6. Telson cleft armed with 5-6 spines on either side (Fig. 2.45B). ..... A.laticauda
--- Telson with shallow apical emargination. 7

Fig. 2.44 Genus Anisomysis

A A.bipartoculata anterior of male x25.
(From Ii, 1964 Fig. 146C).

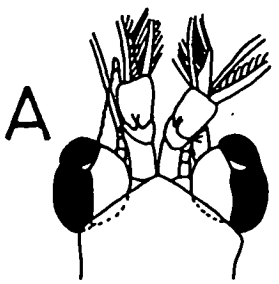
B A.bipartoculata telson.
(After Bacescu, 1973a Fig. 2D).

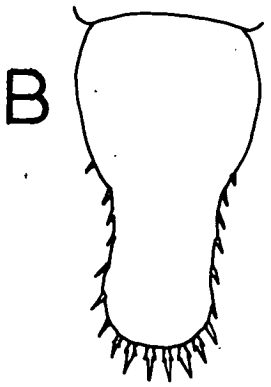
C A.hispida anterior of male.

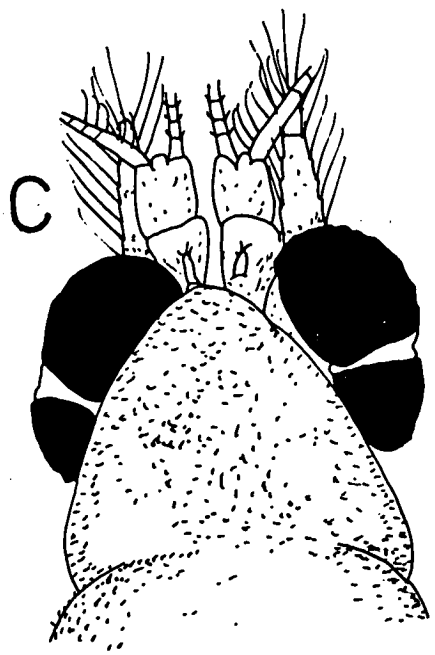
D A.hispida telson and uropod.
(Figs. C & D after Pillai, 1973 Figs. 62B & C respectively; no scale provided).

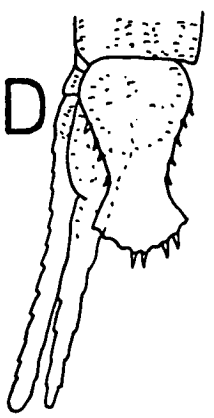
E A.mixta telson and uropod x43.
(Zimmer, 1918 Fig. 28).

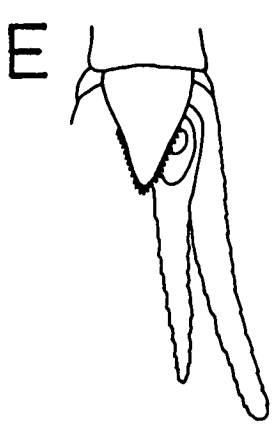
F A.mixta australis telson.
(After Bacescu, 1973a Fig. 2E).


A


B


C


D


E

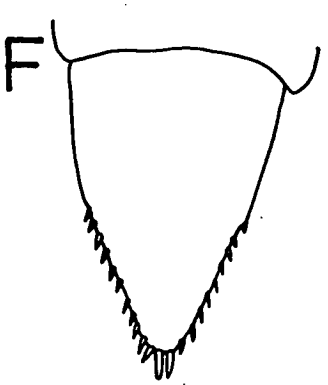

F

Fig. 2.45 Genus Anisomysis

A A.lamellicauda telson.
(After Bacescu, 1973a Fig. 2A).

B A.laticauda telson.
(After Bacescu, 1973a Fig. 2I).

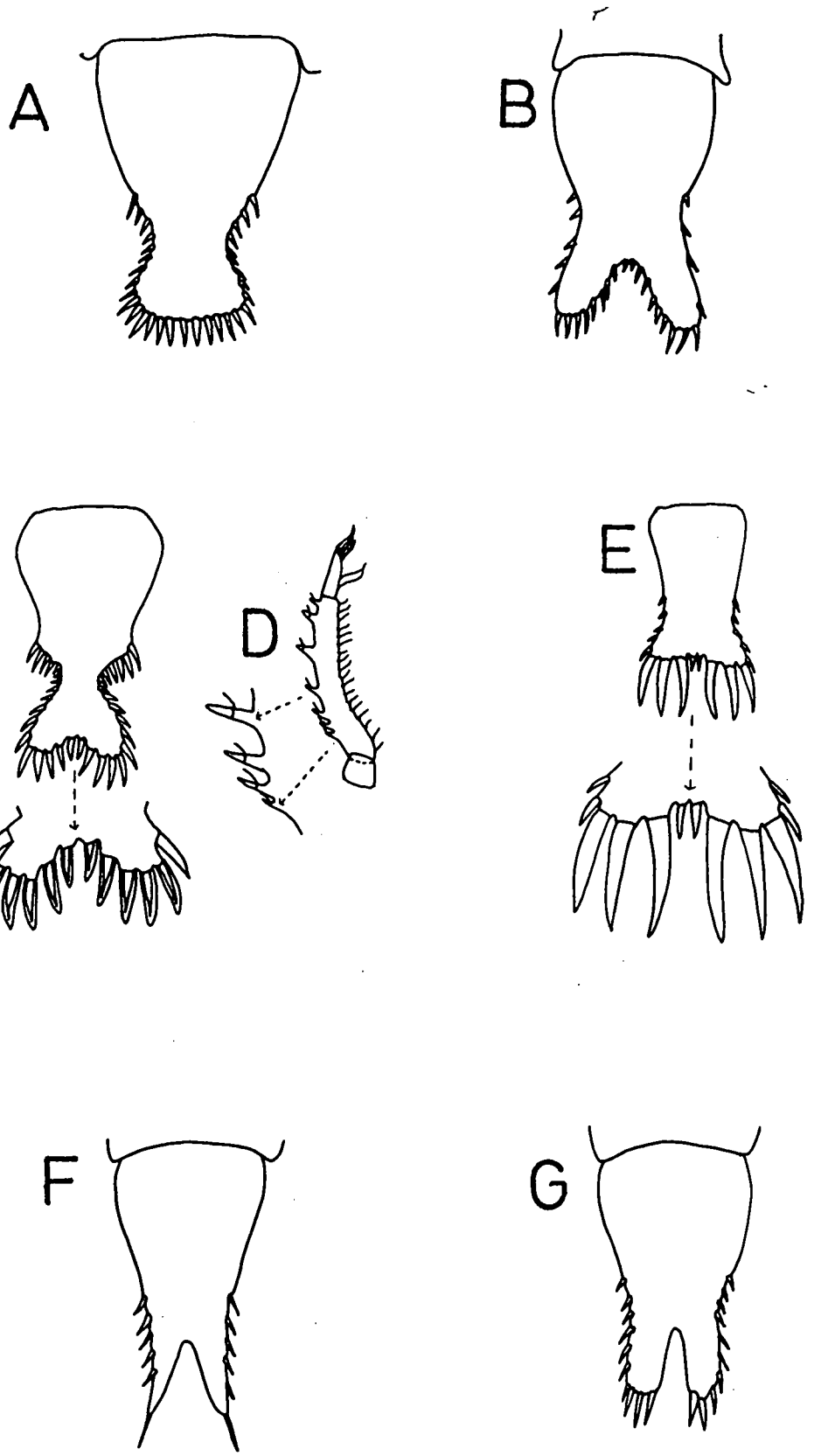
C A.gracilis telson.

D A.gracilis mandibular palp.
(Figs. C & D after Panampunnayil, 1984 Figs. 16, 17 & 4 respectively; scale 3cm = 0.5mm for Figs. 16 & 4; 1.3cm = 0.1mm Fig. 17).

E A.robustispina telson.
(After Panampunnayil, 1982 Figs. 37 & 38; scale 3.0cm = 0.5mm for Fig. 37; 1.3cm = 0.1mm for Fig. 38).

F A.pelewensis telson.
(After Bacescu, 1973a Fig. 2k).

G A.incisa telson.
(After Bacescu, 1973a Fig. 2J).


A
B
C
D
E
F
G

7. Telson markedly constricted at 2/3 from base (Fig. 2.45C). Second segment of mandibular palp with 7 flagellate tubercles along inner margin (Fig. 2.45D). Sub.g. Paranisomysis. .... A.gracilis

--- Telson almost rectangular but with slightly constricted lateral margin 2/3 from base, apical spines long and stout (Fig. 2.45E). Mandibular palp with setae along inner margin. .... A.robustispina

8. Apical lobes of telson pointed with only 1 spine (Fig. 2.45F). ..... A.pelewensis

--- Apical lobes of telson rounded with 3 spines (Fig.2.45G). .... A.incisa

Anisomysis bipartoculata Ii, 1964

Diagnosis. Ii, 1964.

Known Distribution. 30°N-1°S off-shore (Mauchline and Murano, 1977); Japan and South China Sea (Ii, 1964).

Australian Records.

1) Panampunnayil (1984): South-west coast of Australia between 33°14'S-35°16'S and 114°28'E-119°29'E. Horizontal or oblique hauls between 40-0m.

A.gracilis Panampunnayil, 1984

Diagnosis. Panampunnayil, 1984.

Known Distribution. Australia.

Australian Records.

1) Panampunnayil (1984): South-west coast of Australia between 33°14'S-35°16'S and 114°28'E-119°29'E. Horizontal or oblique hauls between 40-0m.

A.hispida Pillai, 1973

Diagnosis. Pillai, 1973.

Known Distribution. 15°N-20°S (Mauchline and Murano, 1977); Indian Ocean (Pillai, 1973).

Australian Records.

1) Pillai (1973): West coast of Australia; Station 219.

A.incisa W.M. Tattersall, 1936a

Diagnosis. W.M. Tattersall, 1936a; Ii, 1964.

Known Distribution. 35°N and 15°S coastal (Mauchline and Murano, 1977); Pelew Is. (Ii, 1964).

Australian Records.

1) W.M. Tattersall (1936a): Great Barrier Reef, Low Isles Anchorage and Barrier Reef Lagoon.
2) Australian Museum Collection: Great Barrier Reef, Lizard Island.

A.lamellicauda Hansen, 1912

Diagnosis. Hansen, 1912

Known Distribution. 16°S Fiji (Mauchline and Murano, 1977; Hansen, 1912).

Australian Records.

1) Australian Museum Collection: Great Barrier Reef, Lizard Island.
2) South Australian Museum: South Australia, McLarens Pt., badly preserved juvenile, identification therefore not positive.

A.laticauda Hansen, 1910

Diagnosis. Hansen, 1910.

Known Distribution. 0-15°S (Mauchline and Murano, 1977); East Indies (Hansen, 1910).

Australian Records.

1) Australian Museum Collection: Great Barrier Reef, Lizard Island.

A.mixta australis (Zimmer, 1918)

Diagnosis. Zimmer, 1918; lowered to sub-species level of A.mixta Nakazawa, 1910 by Bacescu (1973a).

Known Distribution. A.mixta known only from Japan; A.mixta australis known only from Australia.

Australian Records.

1) Zimmer (1918): Victoria, Port Phillip Bay.
2) W.M. Tattersall (1927): South Australia, Vivonne Bay south coast of Kangaroo Island; New South Wales, Port Hacking.
3) Australian Museum Collection: Great Barrier Reef, Lizard Island.
4) Tasmanian Museum Collection: Tasmania, Taroona.
5) Tasmania: One Tree Point; Sloping Island; Hog Island; Fulham Island; Greenhead; Recherche Bay; Passage Beach North, Schouten Island; Granville Harbour; Sandspit Pt. Schouten Island; Adventure Bay.

A.pelewensis Ii, 1964

Diagnosis. Ii, 1964.

Known Distribution. 8°N coastal Pelew (Ii, 1964).

Australian Records.

1) Australian Museum Collection: Great Barrier Reef, Lizard Island.

A.robustispina Panampunnayil, 1984

Diagnosis. Panampunnayil, 1984.

Known Distribution. Australia.

Australian Records.

1) Panampunnayil (1984): South west coast of Australia between 33°14'S-35°16'S and 114°28'E-119°29'E. Horizontal or oblique hauls between 40-0m.

ii) Genus Halemysis Bacescu and Udrescu, 1984

Diagnosis. Rostrum rounded. Antennular peduncle large, unusual with large strong phanera; as thick as outer flagellum of antennule; located on outer distal corner of first segment; together with 2-3 other setae forming a fan. Labrum rounded. Terminal segment of endopod of maxilla with plumose setae and no spines. Male pleopods 1, 2 and 5 rudimentary as in female. Pleopod 3 of male with endopod cone-shaped and bearing setae. Pleopod 4 without endopod; exopod composed of 5 segments; sympod long. Telson entire, apex broadly rounded armed with spines (Bacescu and Udrescu, 1984).

Remarks. Bacescu and Udrescu (1984) suggest Halemysis shows affinities with the genus Mysidium. However, it is evident that the genus Paramesopodopsis (Fenton, 1985a) is closely related, although the number of segments forming the third and fourth male pleopod is different (discussed further in Paramesopodopsis Remarks).

H.australiensis Bacescu and Udrescu, 1984

Diagnosis. Essentially as in generic diagnosis; fourth male pleopod as in Fig. 2.9D. Apex of telson with approximately 27 spines. Body colour yellowish. Adult length: 7.0-8.5mm.

Known Distribution. Australia.

Australian Records.

1) Bacescu and Udrescu (1984): South Australia, Port Lincoln collected 27-5-1941 by Herbert Hale.
2) South Australian Museum: South Australia, Horseshoe Reef, Christies Beach 4-3-1984.

iii) Genus Idiomysis W.M. Tattersall, 1922

Diagnosis. Body robust and gibbous. Carapace with broadly rounded rostral plate. Eyes very large; eyestalk short. Antennular peduncle of male with densely hirsute terminal lobe. Antennal scale short and broad; greater part of outer margin straight without setae; no distal articulation. Telson very short, broad and triangular, leaving statocyst exposed; margins unarmed. Uropods short, robust sub-equal, no spines present; statocyst large. Male pleopods 1, 2, 3 and 5 rudimentary; pleopod 4 with unsegmented endopod; exopod large unsegmented bearing single long stout terminal seta. Female brood pouch formed by 2 pairs of lamellae (W.M. Tattersall, 1922; Greenwood and Hadley, 1982).

Remarks. Three species are known (Mauchline, 1980); only one has been recorded from Australian waters.

Idiomysis inermis W.M. Tattersall, 1922

Diagnosis. Rostrum broadly rounded. Eyes very large. Antennal scale very short, approximately 2/3 as long as broad; outer margin proximally smooth without setae or prominent distal spine, distally with plumose setae, apex and inner margin setiferous (Fig. 2.8E). Abdominal segments nearly cylindrical, slightly compressed, without conspicuous dorsal bulges. Abdomen flexed sharply in region of segments 3 and 4; uropods similarly flexed with respect to 6th abdominal segment (Fig. 2.8F). Male pleopod 4 very long extending backwards to distal end of uropods; endopod unsegmented, simple; exopod long, unsegmented, terminated by single stout seta. Exopod and endopod of uropod sub-equal; statocyst large. Telson short, broad, triangular with bluntly rounded apex; margin unarmed, entire and smooth (W.M. Tattersall, 1922; Greenwood and Hadley, 1982).

Known Distribution. 8°N Gulf of Manaar, India, littoral (Mauchline and Murano, 1977).

Australian Records.

1) Greenwood and Hadley (1982): Queensland, Moreton Bay, Day's Gutter and Dialba Passage. This was the first record and description of the previously unknown female of the species.
2) South Australian Museum Collection: South Australia, Edithburgh Jetty, 11-3-1984.

iv) Genus Paramesopodopsis n.g. Fenton, 1985a

Diagnosis. Carapace short leaving last thoracic segment exposed; produced in front into a bluntly rounded rostrum, antero-lateral edges rounded. Eyes

very large, extend nearly to end of antennular peduncle, spherical, pigment black. Antennular peduncle fairly robust; male appendage large bearing a brush of setae. Antennal scale longer than antennular peduncle, lanceolate in shape, setose all round, small terminal joint. Mandible with large masticatory surface. Terminal segment of maxilla elongate and bears plumose setae; exopod small. Carpo-propodus of third to seventh thoracic legs divided into 3 segments; 4 segments on eighth thoracic leg. Both endopod and exopod of uropods setose at both lateral and medial sides. Pleopods of male: 1st, 2nd and 5th pairs rudimentary as in female. Third pleopod small, composed of a single jointed lobe and a 2-jointed sympod. Fourth pleopod distinctive with a greatly elongated exopod, extending backwards to end of endopod of uropods. Exopod composed of 7 segments; endopod located on inner distal corner of second sympod. Penultimate or 6th segment bears a strong seta or flagellum and a smaller robust barbed seta or flagellum arises from terminal or 7th segment. Female brood pouch formed by 2 pairs of lamellae.

Remarks. Characteristic features of the genus are the third and fourth pleopods in the male. The genus is probably most closely related to the genus Mesopodopsis (Murano pers. comm.), but there are substantial differences in the number of segments forming the 4th pleopod in the male, shape of the eyes, shape of the telson and general body form. The fourth pleopod of Mesopodoposis characteristically is composed of a 2-segmented endopod and a 3-segmented exopod, whereas, that of Paramesopodopsis rufa is composed of a 7-segmented exopod and has a very small single segmented endopod. Also, the third pleopod is quite unusual in that it is composed of a 2-segmented sympod and a single jointed lobe, compared to that of Mesopodopsis where it is biramous with a 2-jointed exopod and a longer unsegmented endopod (Tattersall & Tattersall, 1951). The eyes of Mesopodopsis are characteristically on long tubular eyestalks compared to the very short eyestalks of P.rufa. In addition the telson of Mesopodopsis is entire, as in P.rufa, but bears a large, strong spine on both lateral borders. Mesopodopsis is generally slender compared to the fairly robust body form of P.rufa.

Paramesopodopsis is closely related to Halemysis (Bacescu and Udrescu, 1984); striking resemblances exist in the shape of the telson, rostrum, eyes, mouthparts, antennal scale and male pleopods. However, the number of segments forming the fourth male pleopod is distinctly different. The exopod of Halemysis is composed of 5 segments, whereas it is composed of 7 segments in Paramesopodopsis n.g. Pleopod three is also different in that the sympod 2 segments in Paramesopodopsis and only 1 segment in Halemysis.

Paramesopodopsis rufa n.g. n.sp. Fenton, 1985a

Material examined. HOLOTYPE: Male 12.5mm long, deposited at the Tasmanian Museum reg. no. G2748 collected at One Tree Point, Bruny Island, Tasmania in 5m of water, October 1982. PARATYPES: 5 females and 5 males are lodged at both the Tasmanian Museum and the Australian Museum, reg. nos. G2749 and P34320 respectively.

Diagnosis. Carapace short, exposing last thoracic segment; produced in front into a bluntly rounded rostrum not covering eyestalks; antero-lateral edges rounded (Fig. 2.46A). Eyes very large, spherical; pigment black, cornea occupies nearly half of eye in dorsal view. Antennal scale 1.5 times length of peduncle; six times as long as broad, small terminal joint, setose at both lateral and medial sides (Fig. 2.46B). Carpo-propodus of third to seventh thoracic legs sub-divided into 3 joints; 4 joints on eighth thoracic leg (Fig. 2.46C). Mouthparts: mandibles with large masticatory surface (Fig. 2.46D). Maxilla with terminal endopod elongate bearing 11-16 plumose setae; exopod small (Fig. 2.46E). Labrum rounded (Fig. 2.46F). Maxillule bears 4 plumose setae on proximal endite (Fig. 2.46G). First and second thoracic legs normal (Figs. 2.47A & B). Telson $^{3}/4$ length of 6th abdominal somite, twice as long as broad; entire, bluntly rounded, armed with numerous small closely-set spines which project posterodorsally at an acute angle with telson (Fig. 2.47C). Endopod of uropods twice as long as telson; exopod of uropods slightly longer than endopod; both endopod and exopod of uropods setose at both lateral and medial sides. Pleopods of male : 1st, 2nd and 5th pairs rudimentary as in female. Third pleopod small, composed of a 2-jointed sympod and a single jointed lobe (Fig. 2.47D). Fourth pleopod distinctive with a greatly elongated exopod extending backwards to end of endopod of uropods (Fig. 2.47E). Exopod composed of 7 segments; second sympod bears a very small endopod in its inner distal corner. Sixth segment bears a strong seta or flagellum, and a smaller (approximately half the size of the latter) robust barbed seta arises from terminal or 7th segment (Fig. 2.47F). Female brood pouch formed by 2 pairs of lamellae.

Both sexes appear fully mature when 9mm in length, measured from the tip of the rostrum to the end of the exopod of the uropods. Maximum size found was a 13.9mm mature female.

Body distinctively bright orange in colour, fading rapidly in formalin.

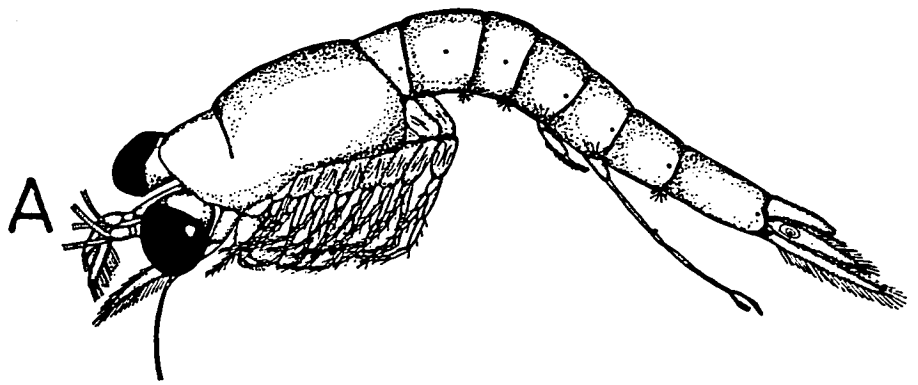
Known Distribution. Australia.

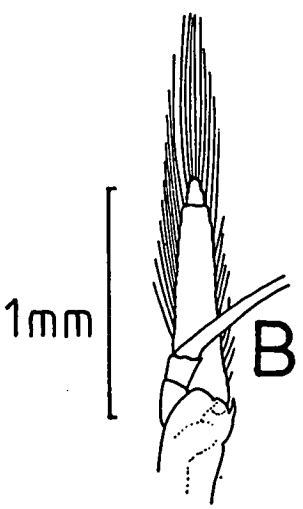
Australian Records.

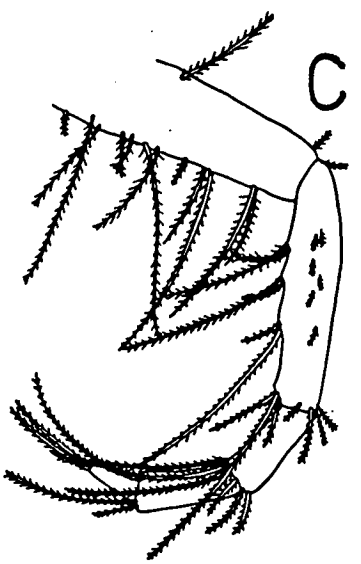
1) Tasmania: One Tree Point, Bruny Island; Sloping Island; Tasman Bay; Isles of Caves; Hog Island; Partridge Island; Waterfall Bay; White

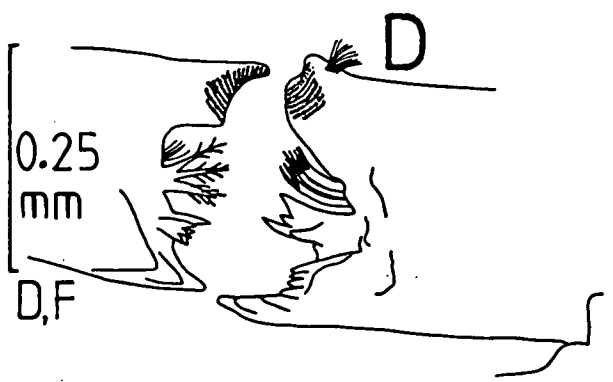
Fig. 2.46 *Paramesopodopsis rufa* n.g. n.sp.

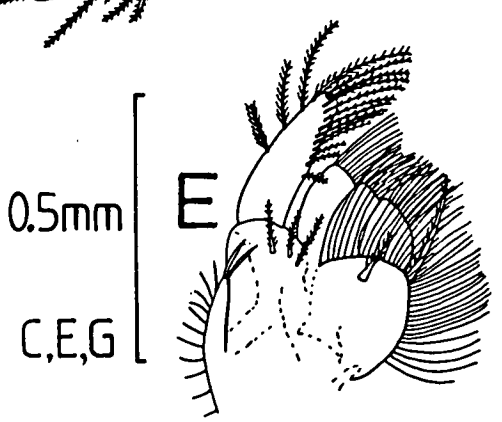
A Adult male, lateral view, 12.5mm in length.
B Antennal scale.
C Thoracic leg.
D Mandibles.
E Maxilla.
F Labrum.
G Maxillule.

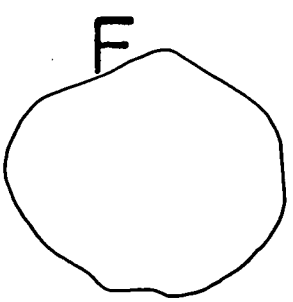

A


1mm
B


C


D
0.25
mm
D,F


0.5mm
C,E,G
E


F

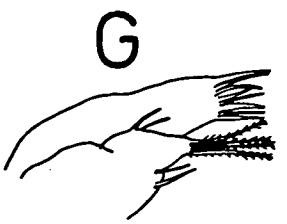
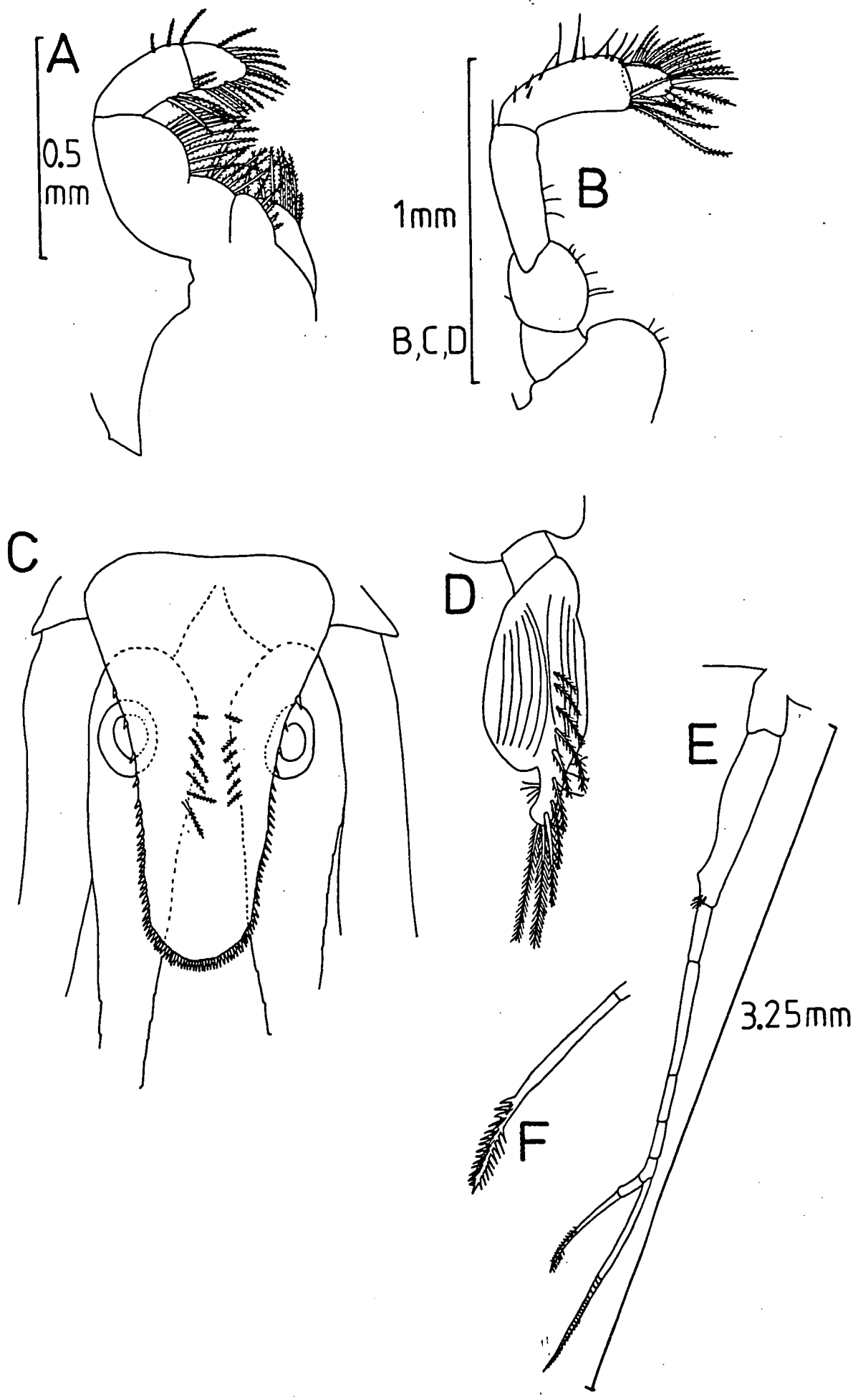

G

Fig. 2.47 Paramesopodopsis rufa n.g. n.sp.

A First thoracic leg.
B Second thoracic leg.
C Telson.
D Third male pleopod.
E Fourth male pleopod.
F Terminal setae of fourth male pleopod.


A
0.5
mm
B
1mm
B,C,D
C
D
E
3.25mm
F

Beach; Sandspit Pt.; Boat Harbour; Taroona Beach; Adventure Bay; Kingston Beach; Southerly Bight; Blow-hole; Maatsuyker Island; Passage Beach Nth., Schouten Island; Moorina Bay; Fortescue Bay.

2) National Museum of Victoria Bass Strait Survey: Station 107.

v) Genus Tasmanomysis n.g. Fenton, 1985b

Diagnosis. Carapace very short exposing last 4 thoracic segments; anterior lateral edges rounded with large spine present on either side of rounded rostrum. Eyestalks markedly elongated; cornea entire, pigment black. Antennal scale narrow, nearly twice as long as antennular peduncle; setose along lateral and medial borders. Carpo-propodus of third to seventh thoracic legs sub-divided into 8 or 9 segments; carpo-propodus of eighth thoracic leg composed of 6 segments. Endopod of uropod bears 2-4 spines on inner margin. Both endopod and exopod setose along lateral and medial borders. Telson shallowly cleft; spines border lateral edges, with a large spine on each apical lobe; smaller spines line cleft. Pleopods of the male: 1st and 2nd pairs uniramous and rudimentary as in female. Pleopods 3, 4 and 5 biramous. Pleopod 3, exopod composed of 3 segments, endopod composed of 2 segments; endopod longer than exopod. Pleopod 4, with a single-segmented endopod and greatly elongate 5-segmented exopod; 4th segment of exopod bears a strong seta or flagellum; smaller seta arises from the terminal segment along with 2 simple setae. Pleopod 5 with unsegmented endopod and 2-segmented exopod; endopod longer than exopod. Female brood pouch formed by 3 pairs of lamellae.

Type-species: Tasmanomysis oculata

Etymology: From the geographic location, Tasmania, southern Australia.

Remarks. Tasmanomysis n.g. can easily be distinguished from all other genera in the Tribe Mysini by the form of the male pleopods, especially pleopods 3 and 5. It closely resembles the genus Arthromysis at least superficially in general body form, shape of the carapace and in the form of the terminal setae of the 4th male pleopod. However, the carpo-propodus of the 3rd-7th thoracic legs is composed of 24-26 segments in Arthromysis whereas in Tasmanomysis the carpo-propodus is composed of only 8-9 segments. Moreover, the number of segments forming the pleopods of the male are quite different in the two genera (Table 2.5).

O.S. Tattersall (1955) commented on the similarity of the genus Arthromysis to Antarctomysis when she described the previously unknown male of Arthromysis magellanica from collections made during the Discovery Expeditions. The main features distinguishing the two genera are the un-

Table 2.5 Comparison of the number of segments forming the male pleopods in the genera Arthromysis and Tasmanomysis n.g.

GENUS	PLEOPOD 3		PLEOPOD 4		PLEOPOD 5	
	EXOPOD	ENDOPOD	EXOPOD	ENDOPOD	EXOPOD	ENDOPOD
Arthromysis	9	1	10	1	15	9
Tasmanomysis n.g	3	2	5	1	2	1

segmented endopods of pleopods 3 and 4 and the long slender eyes of Arthromysis. In contrast, in Antarctomysis the eyestalks are short and both the exopods and endopods of the male pleopods 3-5 are composed of many segments (Tattersall, 1965).

The new genus Tasmanomysis can easily be distinguished from the genera Antarctomysis and Arthromysis by the combination of the form of the pleopods of the males, shape of the telson, armature of the endopod of the uropods and number of segments forming the thoracic legs.

Tasmanomysis oculata n.g. n.sp. Fenton, 1985b

Material examined. HOLOTYPE: Male 16.5mm long, deposited at the Tasmanian Museum reg. no. G2804 collected from the Catamaran River by A. McGifford 23-8-1974. PARATYPES: 6 females and 3 males are lodged at both the Tasmanian Museum and at the Australian Museum, reg. nos. G2805 and P34769 respectively, collected from the Catamaran River by A. McGifford 23-8-1974.

Diagnosis. Body elongate and slender (Fig. 2.48A). Eyestalk represents about 3/5 of the total eye length; pigment black (Fig. 2.48B). Antennal scale approximately 15 times as long as broad (Fig. 2.48C). Labrum rounded, without spiniform process (Fig. 2.49A). Mandibles with well-developed molar; palp relatively large (Fig. 2.49B). Maxillule simple bearing 3 strong setae on proximal endite amongst smaller setae (Fig. 2.49C). Maxilla bears approximately 8 barbed spines interspersed with long plumose setae on terminal endopod (Fig. 2.49D). First and second thoracic legs normal in form (Figs. 2.49E & F). Carpo-propodus of third and seventh thoracic leg 8-segmented (Fig. 2.50A); carpo-propodus of fourth, fifth and sixth thoracic legs 9-segmented; carpo-propodus of eighth thoracic leg 6-segmented (Fig. 2.50B). Setae on outer border of thoracic legs barbed as in Fig. 2.50C. Telson shallowly cleft, about 1/10th its length; 17-23 spines border lateral edges of telson and 23-26 line each side of cleft; a large spine arms each apical lobe. Telson almost twice as long as broad (Figs. 2.50D & E). Endopod of uropod slightly longer than telson; 2-4 spines present on inner margin. Exopod of uropod entire, twice as long as telson. Both rami bear setae on their lateral and medial margins (Fig. 2.50F). Pleopods of the male: pleopod 3 with 3-segmented exopod and 2-segmented endopod (Fig. 2.50G). Pleopod 4 with single segmented endopod and greatly elongate 5-segmented exopod; 4th segment bears a strong seta or flagellum; a similar but smaller seta arises from terminal segment along with 2 simple setae (Fig. 2.50H). Pleopod 5 with unsegmented endopod and a 2-segmented exopod (Fig. 2.50I).

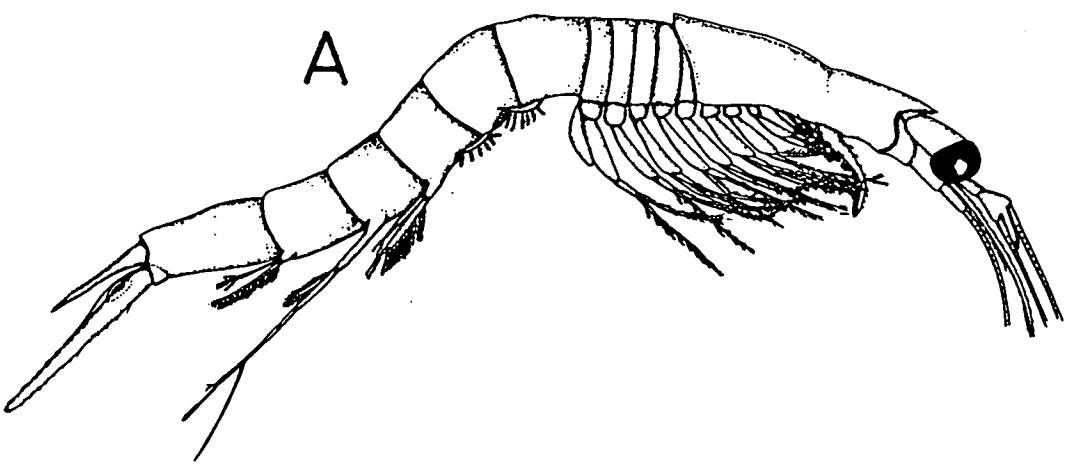
Adult length: 16.5-18.0mm, measured from the tip of the rostrum to the end of the exopod of the uropods.

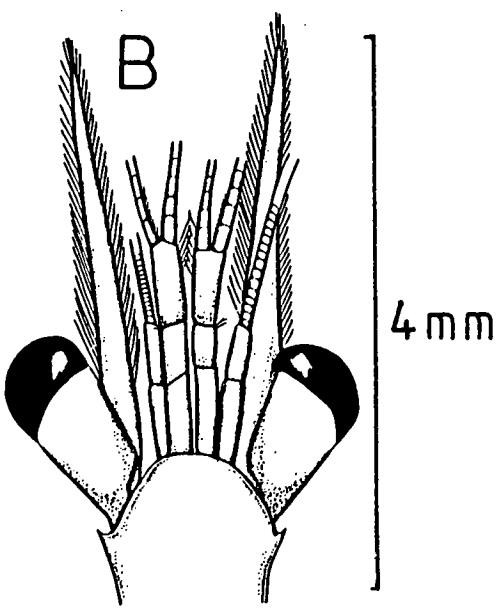
Fig. 2.48 Tasmanomysis oculata n.g. n.sp.

A Adult male, lateral view, 16.5mm in length.

B Anterior of female.

C Antennal scale.


A


B
4 mm

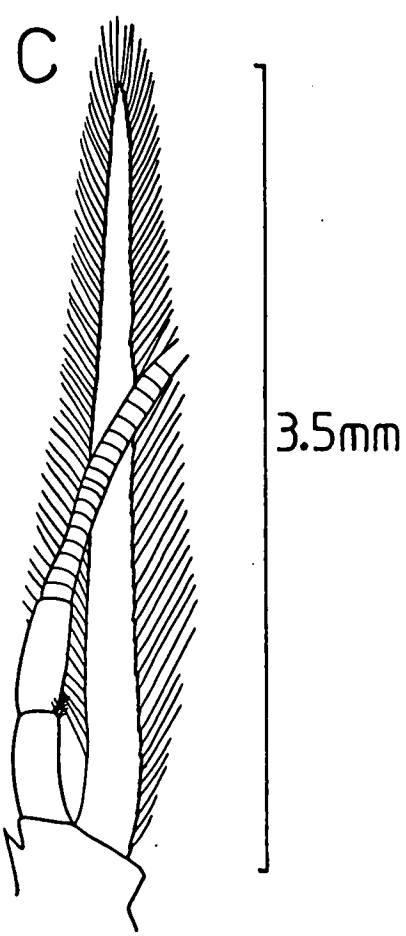

C
3.5mm

Fig. 2.49 Tasmanomysis oculata n.g. n.sp.

A Labrum.

B Mandible.

C Maxillule.

D Maxilla.

E First thoracic leg.

F Second thoracic leg.

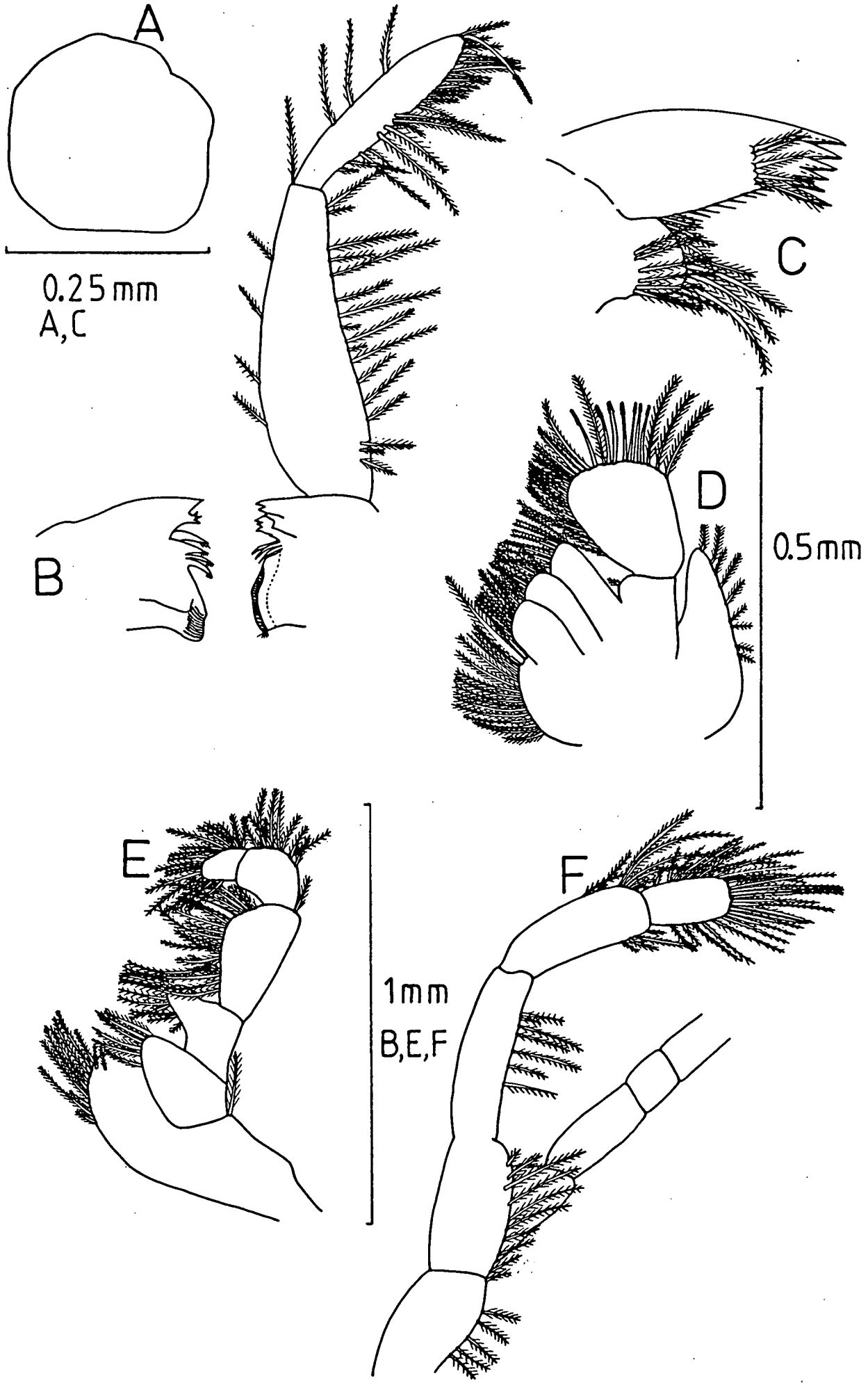
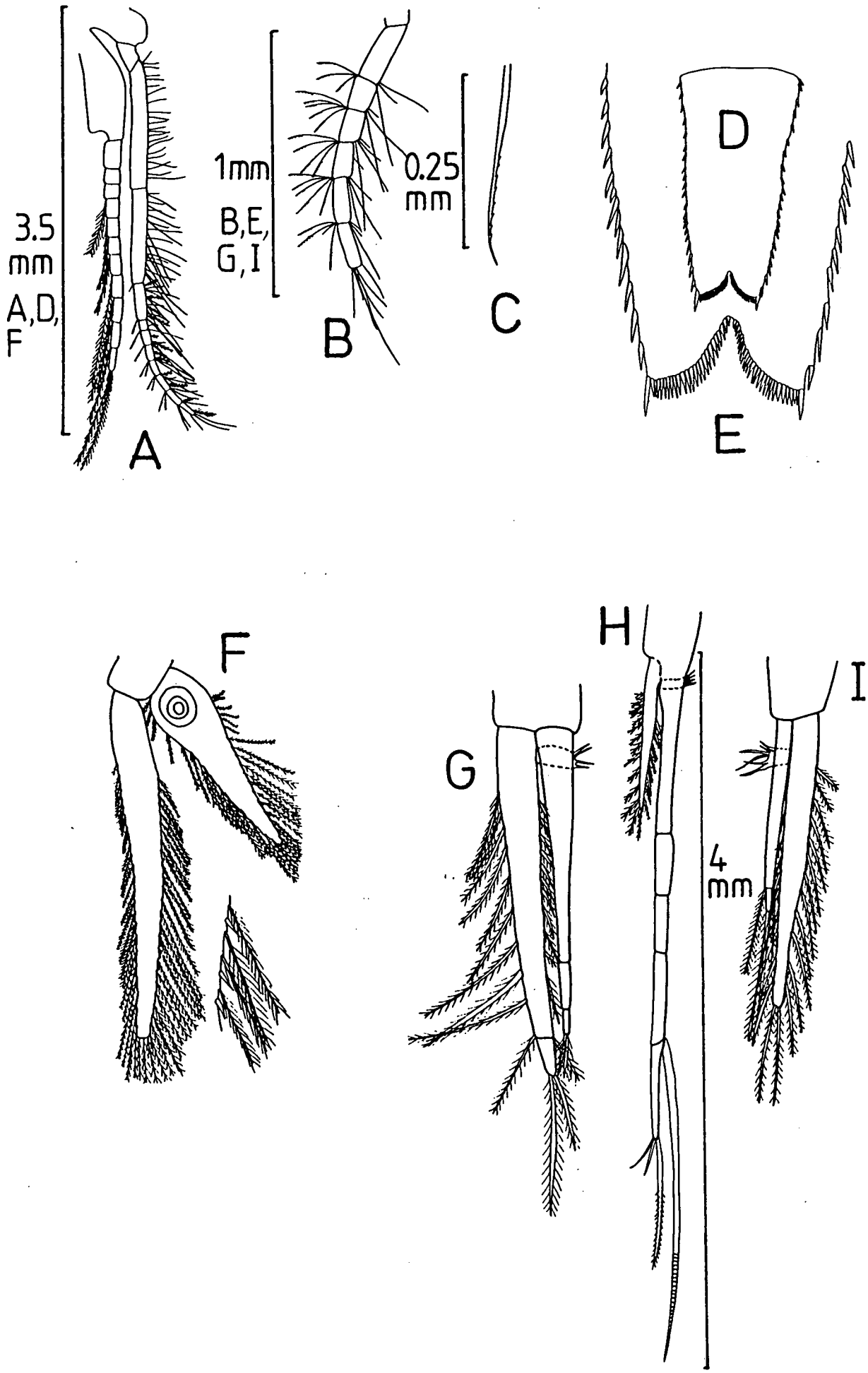

A
0.25 mm
A,C
C
B
D
0.5 mm
E
F
1 mm
B,E,F

Fig. 2.50 Tasmanomysis oculata n.g. n.sp.

A Third thoracic leg.
B Eighth thoracic leg.
C Barbed seta from thoracic leg.
D Telson.
E Apical cleft of telson.
F Uropods.
G Male pleopod 3.
H Male pleopod 4.
I Male pleopod 5.


3.5
mm
A,D,
F
A
1mm
B,E,
G,I
B
0.25
mm
C
D
E
F
G
H
4
mm
I

Etymology: From the conspicuous elongate eyes.

Known Distribution. Australia.

Australian Records.

1) Tasmania: Catamaran River; D'Entrecasteaux Channel collected in surface plankton hauls, salinity 34.8 $^{o}/_{oo}$, temperature 17.8°C; plankton hauls between Tinderbox and Bruny Island; Adventure Bay; One Tree Point, Bruny Island.

D) Tribe Heteromysini

Definition. Eyes globular, cylindrical or quadrangular. Antennal scale small, ovate, setose along lateral and medial borders. Endopods of thoracic limbs 3-8 with carpus and propodus fused; undivided in third pair but divided by several transverse articulations in pairs 4-8. Pleopods of both sexes rudimentary. Telson with cleft armed with spines (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. Four genera belong in the Tribe Heteromysini (Brattegard, 1980; Mauchline, 1980), two of which are represented in Australian waters.

i) Genus Heteromysis S.I. Smith, 1874

Diagnosis. Eyes globular and cylindrical; cornea normal, located at distal end of eyestalk. Antennal scale short, ovate, apex rounded; setose along lateral and medial borders. Carpus and propodus of third thoracic endopod fused, undivided and strongly thickened with modified spines; small dactylus with large nail bending over to form large prehensile claw. Carpopropodus of thoracic endopods 4-8 slender and divided into sub-segments. Pleopods of both sexes rudimentary. Male genital appendage at base of eighth thoracic legs, long and cylindrical. Male sternal processes may be present on all or a few of thoracic segments 2-7. Antennular peduncle of male with lobe reduced to merely a ridge with a few setae. Female with 2 pairs of brood lamellae. Abdominal somites without pleural plates. Body not dorso-ventrally compressed (Tattersall and Tattersall, 1951; Ii, 1964; Modlin, 1984).

Remarks. Over 45 species are known in this genus (Mauchline, 1980); 10 have been recorded from Australia among several sub-genera of Heteromysis (Bacescu, 1968a). Species in the genus are often associated with a cryptic habitat and frequently are found living in association with sponges and corals.

Key to the Australian Species of Heteromysis

1. Lateral edges of telson armed throughout their length with spines, with or without a median hiatus. 2
--- Lateral edges of telson armed with spines on distal half only. 5

2. Lateral edges of telson with median hiatus. 3
--- Lateral edges of telson without median hiatus. 4

3. Endopod of uropod with 4 spines below statocyst (Fig. 2.51A). Thoracic legs 4-8 with 6-segmented tarsus (Fig. 2.51B). Telson with small gap between apical spines and start of cleft spines (Fig. 2.51C). ..... H.macrophthalma
--- Endopod of uropod with row of approximately 11 spines extending from statocyst nearly to apex. Thoracic legs 4-8 with 4-segmented tarsus (Fig. 2.51D). Telson with wide gap between apical spines and start of cleft spines (Fig. 2.51E). ..... H.zeylanica

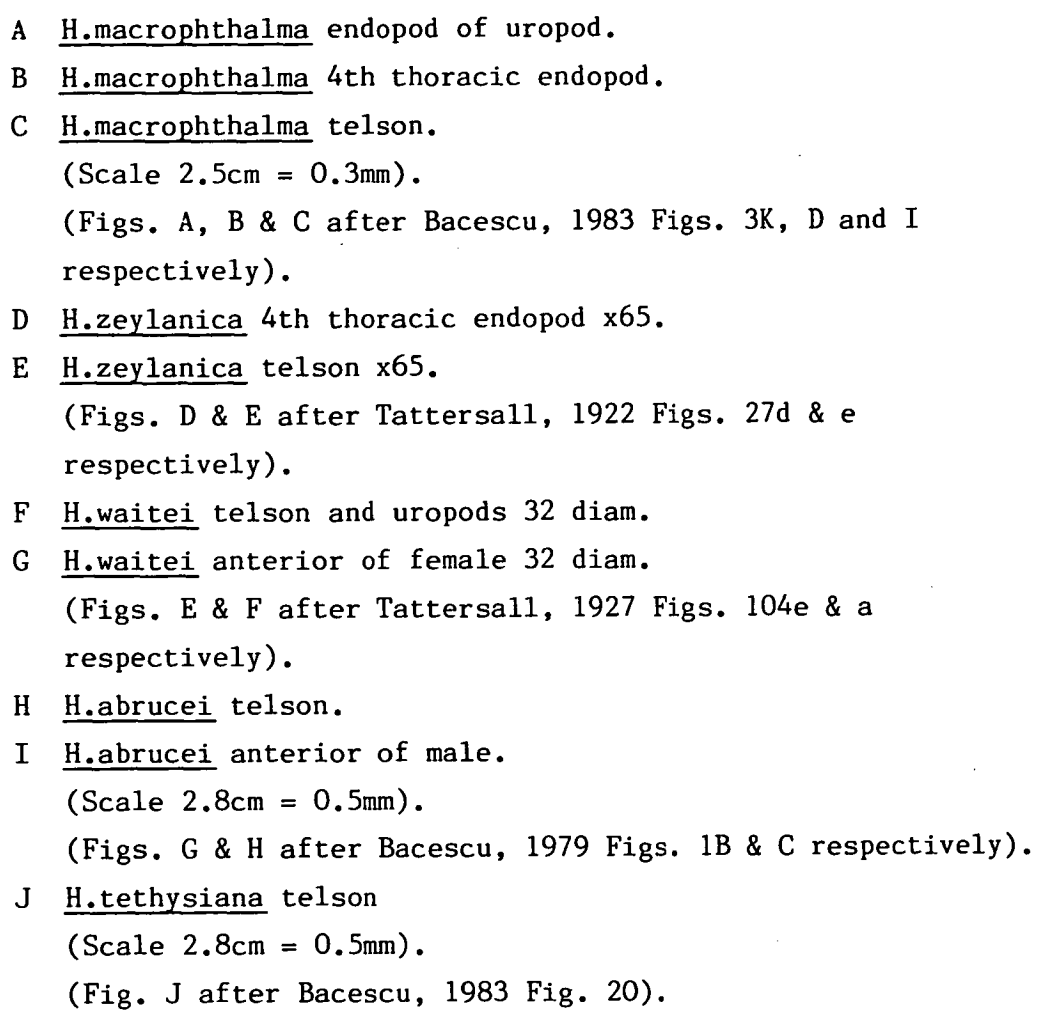
4. Cleft of telson armed throughout by spines (Fig. 2.51F). Eyestalks short and thick with ocular papilla (Fig. 2.51G). .... H.waitei
--- Cleft of telson with spines, but with a gap between the apical spines and the start of the cleft spines (Fig. 2.51H). Eyestalks slender with ocular papilla (Fig. 2.51I). ..... H.abrucei

5. No spine on endopod of uropod. Lateral margins of telson armed with 5 spines (Fig. 2.51J). ..... H.tethysiana
--- At least one spine present on the endopod of uropod. 6

6. Endopod of uropod with one large spine located below statocyst. Apex of telson with small spine on outside of large spine; lateral margins of telson with 7 spines (Fig. 2.52A). .... H.australica
--- Endopod of uropod with more than one spine. Apex of telson with small spines on inner side of large spine; lateral margins of telson with more than 7 spines. 7

7. Endopod of uropod with 2 spines (Fig. 2.52B). Lateral margins of telson with more than 7 spines (Fig. 2.52C). ..... H.heronensis

Fig. 2.51 Genus Heteromysis



A H.macrophthalma endopod of uropod.
B H.macrophthalma 4th thoracic endopod.
C H.macrophthalma telson.
(Scale 2.5cm = 0.3mm).
(Figs. A, B & C after Bacescu, 1983 Figs. 3K, D and I respectively).
D H.zeylanica 4th thoracic endopod x65.
E H.zeylanica telson x65.
(Figs. D & E after Tattersall, 1922 Figs. 27d & e respectively).
F H.waitei telson and uropods 32 diam.
G H.waitei anterior of female 32 diam.
(Figs. E & F after Tattersall, 1927 Figs. 104e & a respectively).
H H.abrucei telson.
I H.abrucei anterior of male.
(Scale 2.8cm = 0.5mm).
(Figs. G & H after Bacescu, 1979 Figs. 1B & C respectively).
J H.tethysiana telson
(Scale 2.8cm = 0.5mm).
(Fig. J after Bacescu, 1983 Fig. 20).

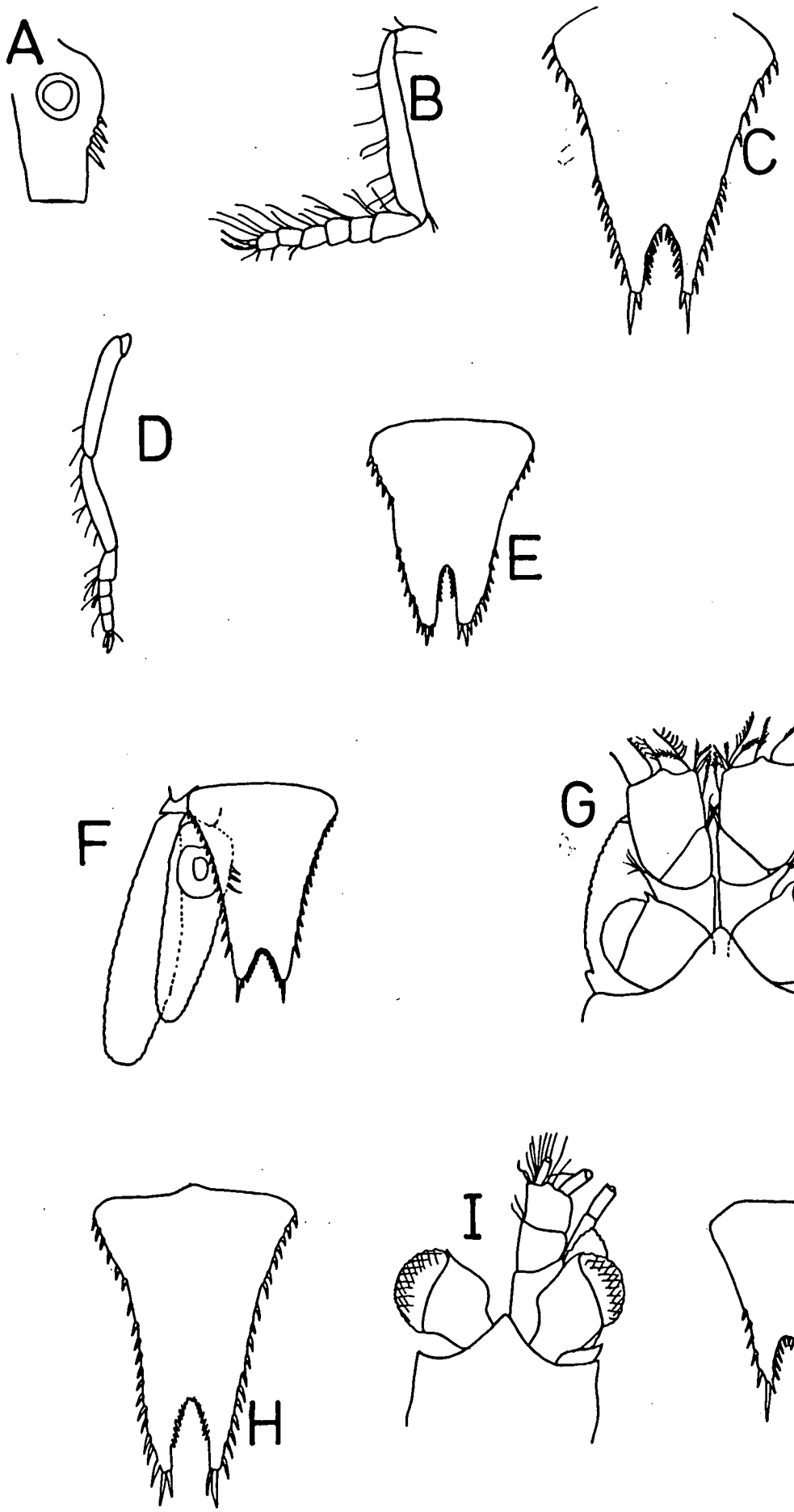

A
B
C
D
E
F
G
H
I
J

Fig. 2.52 Genus Heteromysis

A H.australica telson and uropods.
(Scale 3.6cm = 0.5mm).
(After Bacescu and Bruce, 1980 Fig. 1M).

B H.heronensis female endopod of uropod.
(Scale 1.8cm = 0.2mm).

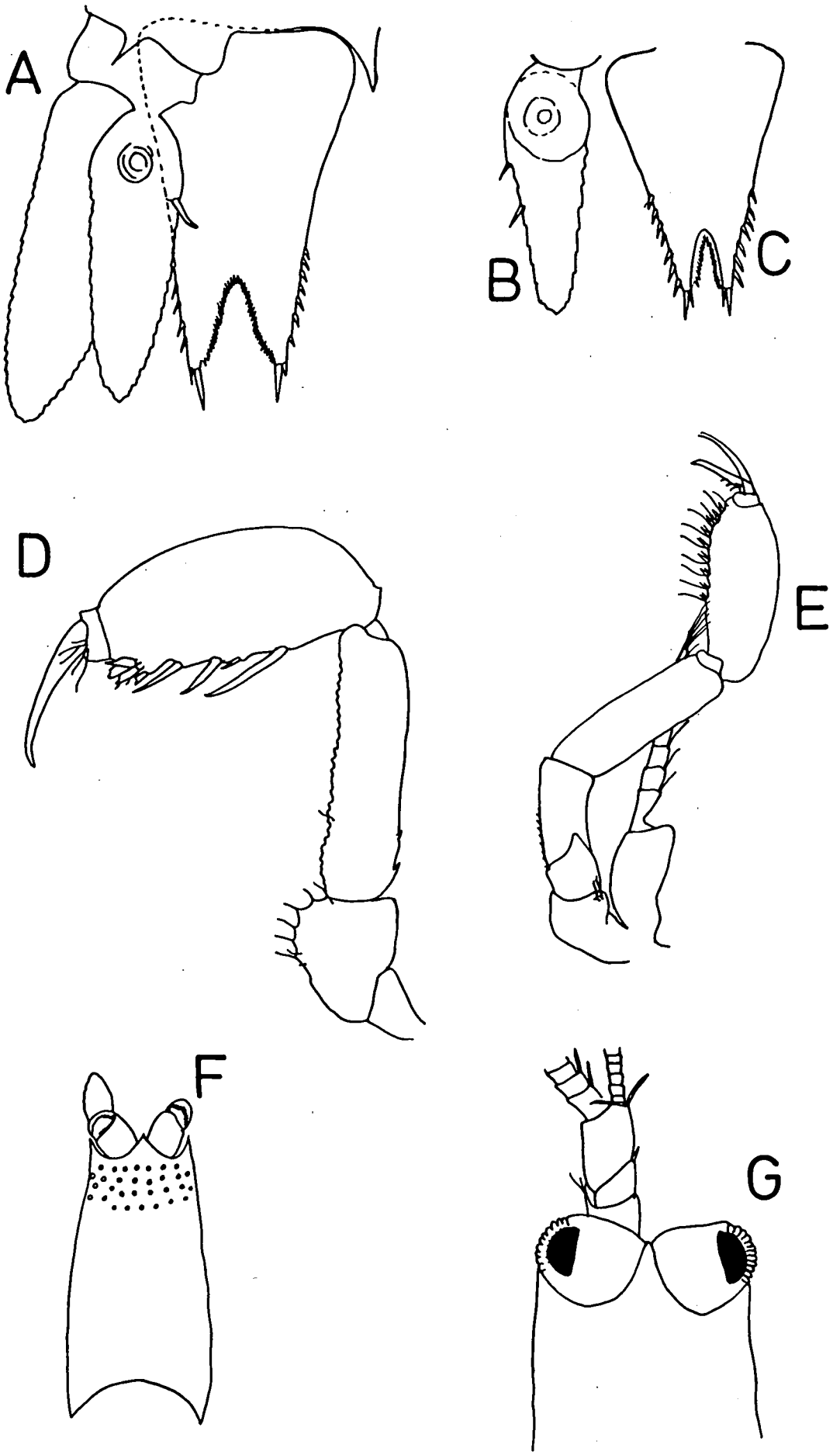
C H.heronensis male telson
(Scale 2.8cm = 0.4mm).
(Figs. B & C after Bacescu, 1979 Figs. 1M & K).

D H.stellata female third thoracic leg.
(Scale 2.1cm = 0.5mm).
(After Bacescu and Bruce, 1980 Fig. 2E).

E H.tasmanica third thoracic limb; 22 diam.
(After Tattersall, 1927 Fig. 105b).

F H.stellata male; dorsal view.
(Scale 2cm = 1mm).
(After Bacescu and Bruce, 1980 Fig. 2B).

G H.harpaxoides anterior portion of cephalothorax.
(Scale 2.2cm = 0.5mm).
(After Bacescu and Bruce, 1980 Fig. 3A).


A
B
C
D
E
F
G

--- Endopod of uropod with 14-17 spines. Lateral margins of telson with 10-16 spines. 8

8. Third thoracic leg with merus serrated (Fig. 2.52D). 9
--- Third thoracic leg with merus smooth (Fig. 2.52E). .... H.tasmanica

9. Crown of tubercles present on carapace (Fig. 2.52F). .... H.stellata
--- No crown of tubercles (Fig. 2.52G). ..... H.harpaxoides

Heteromysis (Olivaemysis) abrucei Bacescu, 1979

Diagnosis. Bacescu, 1979.
Known Distribution. Australia.
Australian Records.
1) Bacescu (1979): Great Barrier Reef, Heron Island Moore Reef.

H.(Heteromysis) australica Bacescu and Bruce, 1980

Diagnosis. Bacescu and Bruce, 1980.
Known Distribution. Australia.
Australian Records.
1) Bacescu and Bruce (1980): Great Barrier Reef, Heron Island, on Porites andrewsii reef flat.

H.(Gnathomysis) harpaxoides Bacescu and Bruce, 1980

Diagnosis. Bacescu and Bruce, 1980.
Known Distribution. Australia.
Australian Records.
1) Bacescu and Bruce (1980): Great Barrier Reef, Wistari Reef, from the shells inhabited by the hermit crab Dardanus megistor.

H.(Heteromysis) heronensis Bacescu, 1979

Diagnosis. Bacescu, 1979.
Known Distribution. Australia.
Australian Records.
1) Bacescu (1979): Great Barrier Reef, Moore Reef, near Heron Island in Acropora.

H. (Olivaemysis) macrophthalma Bacescu, 1983

Diagnosis. Bacescu, 1983.

Known Distribution. Australia.

Australian Records.

1) Bacescu (1983): Great Barrier Reef, Heron Island.

H.(Gnathomysis) stellata Bacescu and Bruce, 1980

Diagnosis. Bacescu and Bruce, 1980.

Known Distribution. Australia.

Australian Records.

1) Bacescu and Bruce (1980): Great Barrier Reef, Heron Island, southern reef edge, algal crest.

H.(Heteromysis) tasmanica W.M. Tattersall, 1927

Diagnosis. W.M. Tattersall, 1927.

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1927): Tasmania, D'Entrecasteaux Channel in 1914; South Australia, Gulf of St. Vincent.
2) National Museum of Victoria Bass Strait Survey: Stations 108, 116, 138, 181 and 209.

H.tethysiana Bacescu, 1983

Diagnosis. Bacescu, 1983.

Known Distribution. Australia.

Australian Records.

1) Bacescu (1983): Great Barrier Reef, Heron Island.

H.(Olivaemysis) waitei W.M. Tattersall, 1927

Diagnosis. W.M. Tattersall, 1927.

Known Distribution. Australia.

Australian Records.

1) W.M. Tattersall (1927): South Australia, Gulf of St.Vincent and Outer Harbour.
2) National Museum of Victoria Bass Strait Survey: Stations 108 and 109.
3) South Australian Museum: South Australia, Outer Harbour, poor condition thus identification not positive.

H.(Olivaemysis) zeylanica W.M. Tattersall, 1922

Diagnosis. W.M. Tattersall, 1922.

Known Distribution. 10°N-6°S Gulf of Maanar, Indian coast (Mauchline and Murano, 1977; W.M. Tattersall, 1922).

Australian Records.

1) Bacescu (1983): Great Barrier Reef, Heron Island.

ii) Genus Heteromysoides Bacescu, 1968a

Diagnosis. Eyes small, quadrangular in dorsal view; cornea nearly elliptical located asymmetrically on antero-lateral corner of eyestalk. Antennular peduncle with only a few setae; male lobe resembles rough tubercle (Bacescu, 1968a).

Remarks. Three species have been described in this genus (Mauchline, 1980); only one is known from Australia.

Heteromysoides longiseta Bacescu, 1983

Diagnosis. Eyes dorso-ventrally flattened, broader than long. Cornea small, located on antero-lateral corner of eyestalk (Fig. 2.5B). Antennular peduncle with 2 diverging setae on inner distal margin. Male lobe resembles rough tubercle (Fig. 2.53A). Pleopods of both sexes alike, with long basis and enormous corrugated distal setae (Fig. 2.53B) (Bacescu, 1983).

Known Distribution. Australia.

Australian Records.

1) Bacescu (1983): Great Barrier Reef, Heron Island.

2.3.2.2.6 Sub-family MYSIDELLINAE

Definition. Labrum unusual and distinctive, posteriorly produced into a large plate divided by deep incision forming two unequal lobes. Mandibles unusual, cutting lobe expanded greatly with straight edge and without teeth. Maxillule with lobes bending strongly inward; outer lobe distally broad; armed with strong spines; inner lobe armed with stout spinose setae. Sixth segment of first thoracic endopod expanded and armed with spines. Carpo-propodus of thoracic legs 3-8 divided by 1-2 transverse articulations. Pleopods of both sexes rudimentary. Exopod of uropod entire; outer margin with setae and no spines. Telson cleft (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. The sub-family is represented by only one genus, Mysidella.

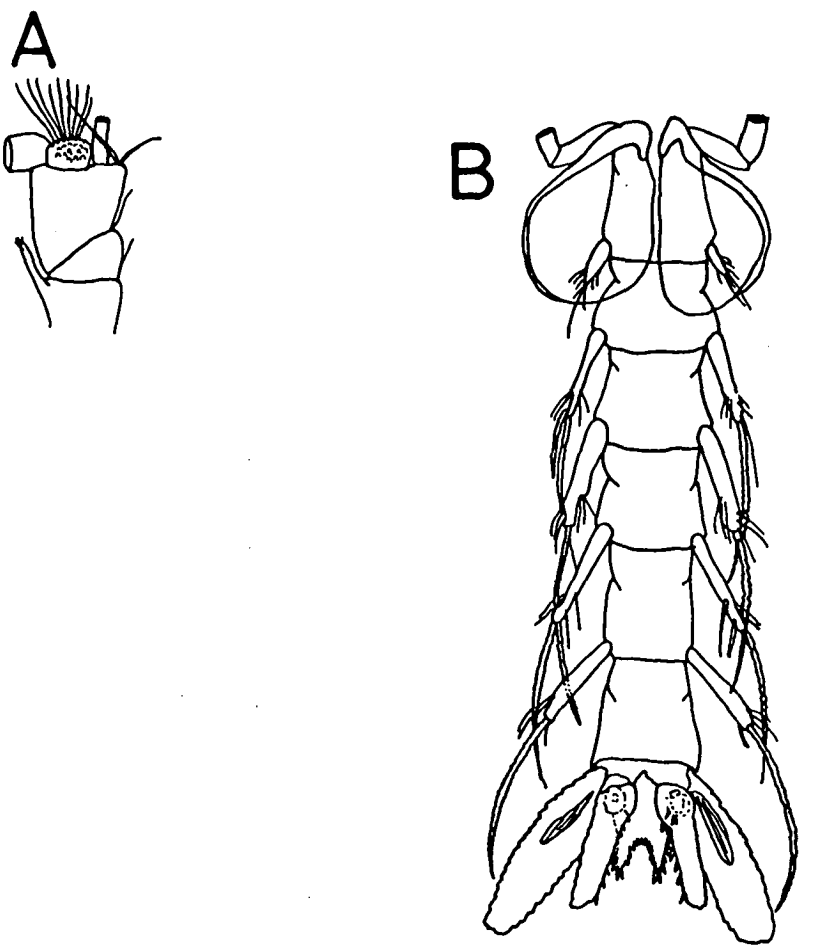


Fig. 2.53 Heteromysoides longiseta

A Male antennular peduncle.
(Scale 3.3cm = 0.5mm).

B Female abdomen, ventral view.
(Scale 1.6cm = 0.5mm).
(Figs. A & B after Bacescu, 1983 Fig. 1D & B respectively).

i) Genus Mysidella G.O. Sars, 1872

Diagnosis. Essentially as in sub-family definition. General body form short and robust. Antennular peduncle of male with setose lobe small and nodular. Antennal scale small, setose along lateral and medial borders; small distal articulation. Maxilla small and feeble, exopod well-developed. Carpopropodus of thoracic endopods 3-8 divided into 2-3 sub-segments. Genital appendage of male at base of eighth thoracic legs forwardly directed, long and cylindrical. Endopod of uropod with spines on inner margin. Telson cleft (Tattersall and Tattersall, 1951; Ii, 1964).

Remarks. In 1872 G.O. Sars established the genus Mysidella to accept two species, M.typhlops from Norway and M.typica from the N.E. Atlantic. It was not until 1948 that another species, M.americana Banner, from Canada, was described. The next two species described were both from Japan, M.tanakai (Ii, 1964) and M.nana (Murano, 1970). In 1973, Brattegard described M.minuta from the Caribbean coast of Columbia, and in 1980, Lagardere and Nouvel described a new species M.biscayensis from the Gulf of Biscay.

The species M.australiana n.sp. from Bass Strait, described here, appears to be the first record of the genus from Australian waters and from the Southern Hemisphere (Mauchline & Murano, 1977; Mauchline, 1980).

Mysidella sp.1 n.sp.

Material examined. HOLOTYPE: Male 6mm long lodged at the National Museum of Victoria reg. no. J11046, collected at Station 115 during the Bass Strait Survey. PARATYPES: 3 females and 1 male lodged at the National Museum of Victoria reg. no. J11047, collected at Station 165 during the Bass Strait Survey.

Diagnosis. General body form compact and robust. Eyes spherical, extending to end of 2nd segment of antennular peduncle, cornea occupies approximately 1/2 stalk in dorsal view; pigment red in alcohol (Fig. 2.54A). Carapace with a bluntly rounded apex extending over eyes slightly; antero-lateral edges rounded; posterior edge dorsally emarginate exposing last thoracic segment. Antennular peduncle of male with a small brush of setae on terminal segment. Antennal scale lanceolate in shape, extending beyond antennular peduncle; with distal articulation, setose along medial and lateral borders (Fig. 2.54B). Labrum large obtusely rounded in front; posteriorly produced into 2 unequal lobes (Fig. 2.54C). Mandible, maxilla and maxillule (Figs. 2.54D, E & F) typical of genus. First thoracic limb: propodus of endopod expanded, larger than carpus; outer distal margin armed with a row of 7 spines (Fig. 2.55A); strong terminal claw approximately same length as

Fig. 2.54 Mysidella sp.1 n.sp.

A Anterior of male.

B Antennal scale.

C Labrum.

D Mandible.

E Maxilla.

F Maxillule.

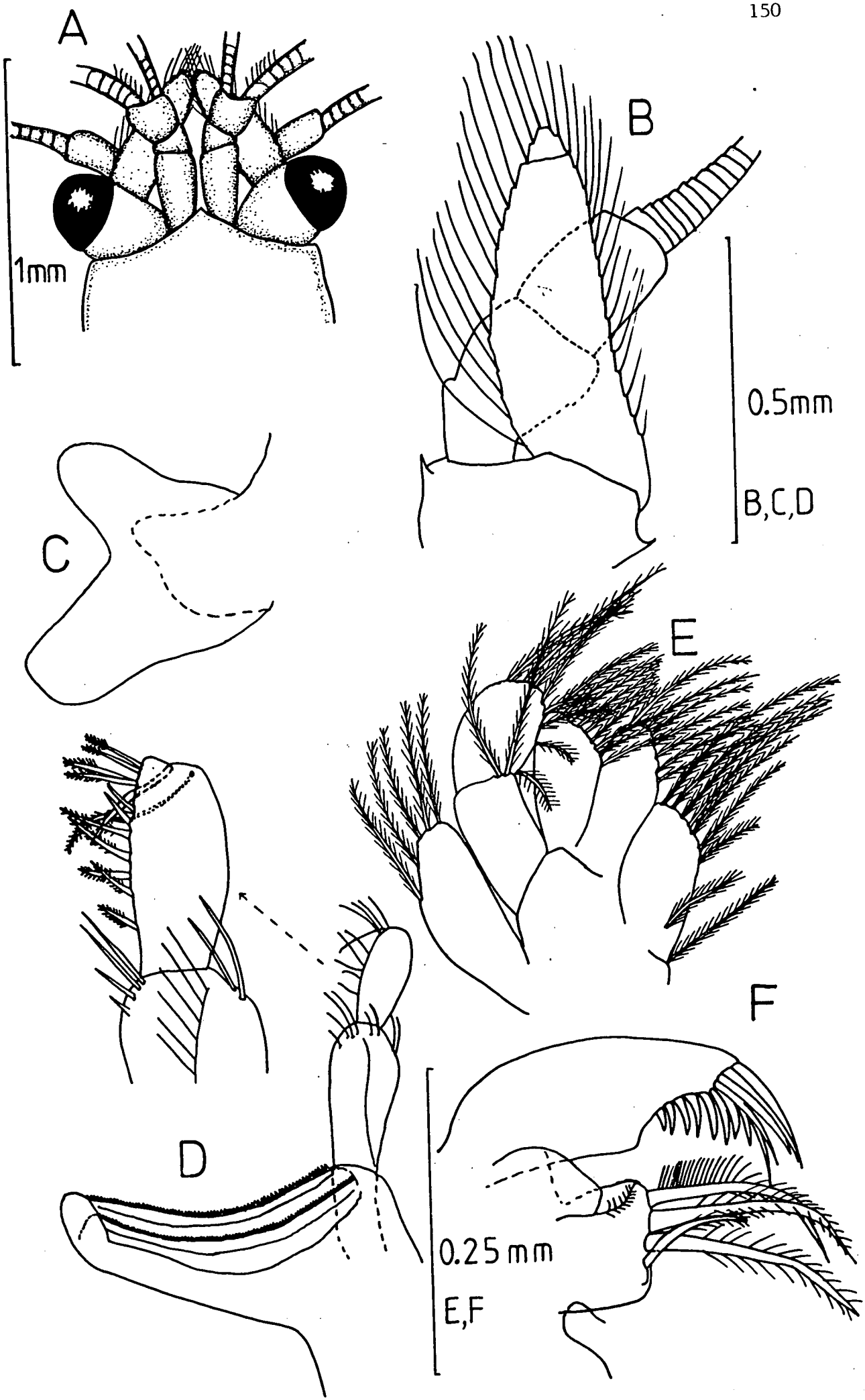
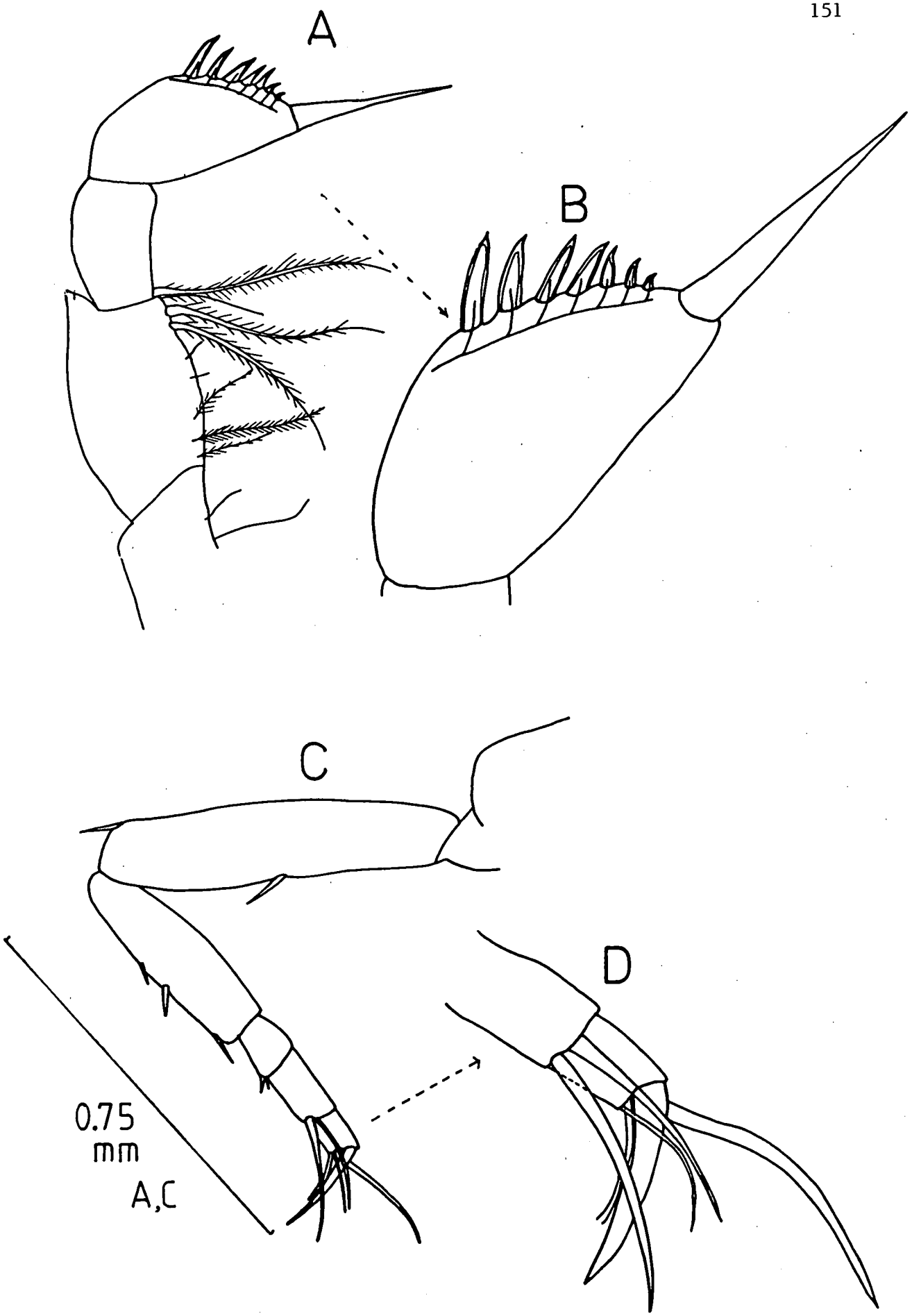

A
1mm
B
0.5mm
B,C,D
C
E
F
D
0.25 mm
E,F

Fig. 2.55 *Mysidella sp.1* n.sp.

A First thoracic endopod.
B Terminal segment of 1st thoracic endopod.
C Sixth thoracic leg.
D Dactylus of 6th thoracic leg.


A
B
C
D
0.75
mm
A,C

dactylus itself (Fig. 2.55B). Thoracic legs 3-8 mostly missing in specimens, 6th thoracic leg as in Figs. 2.55C & D. Genital appendage present on base of eighth thoracic limb: long, cylindrical and directed forward (Fig. 2.56A). Pleopods of both sexes rudimentary and simple. Telson triangular, approximately 1.5 times as long as broad; shallow apical cleft occupying only 1/24 of the total length of telson. Lateral margins with hiatus with 10 spines arming the lower half and 3-4 above the hiatus. Two spines arm each apical lobe, outer spine twice as long as the inner (Fig. 2.56B). Cleft armed with 3 spines on either side (Fig. 2.56C). Uropods: endopod bears a row of approximately 27 spines on inner margin extending from statocyst to apex. Exopod slightly longer than endopod. Both endopod and exopod setose along lateral and medial borders (Fig. 2.56D). Adult length: 4.5-4.7mm, measured from the tip of the rostrum to the end of the exopod of the uropods.

Remarks. M.sp.1 n.sp. is easily distinguished from the other species in the genus by the presence of seven spines on the outer margin of the carpo-propodus of the first thoracic endopod. Most of the species in the genus have three, but M.typhlops has four and M.nana, five spines (Brattegard, 1973; Lagardere and Nouvel, 1980).

In addition, the telson of M.sp.1 n.sp. has a very shallow cleft occupying approximately 1/24 of the length of the telson. The cleft is deeper in all other species, occupying between 1/5-1/12 of the telson length, and in M.typhlops, occupying 1/19 of the telson.

M.sp.1 n.sp. appears to most closely resemble M.typhlops with respect to the telson armature; however, the eyes of M.typhlops are rudimentary and there are only four spines on the first thoracic endopod. In terms of the number of spines on the outer margin of the carpo-propodus of the first thoracic endopod, M.sp.1 n.sp. is closest to M.nana; however, the deep cleft armed with 22 spines is quite different from the shallow cleft with 2-3 spines in M.sp.1 n.sp.

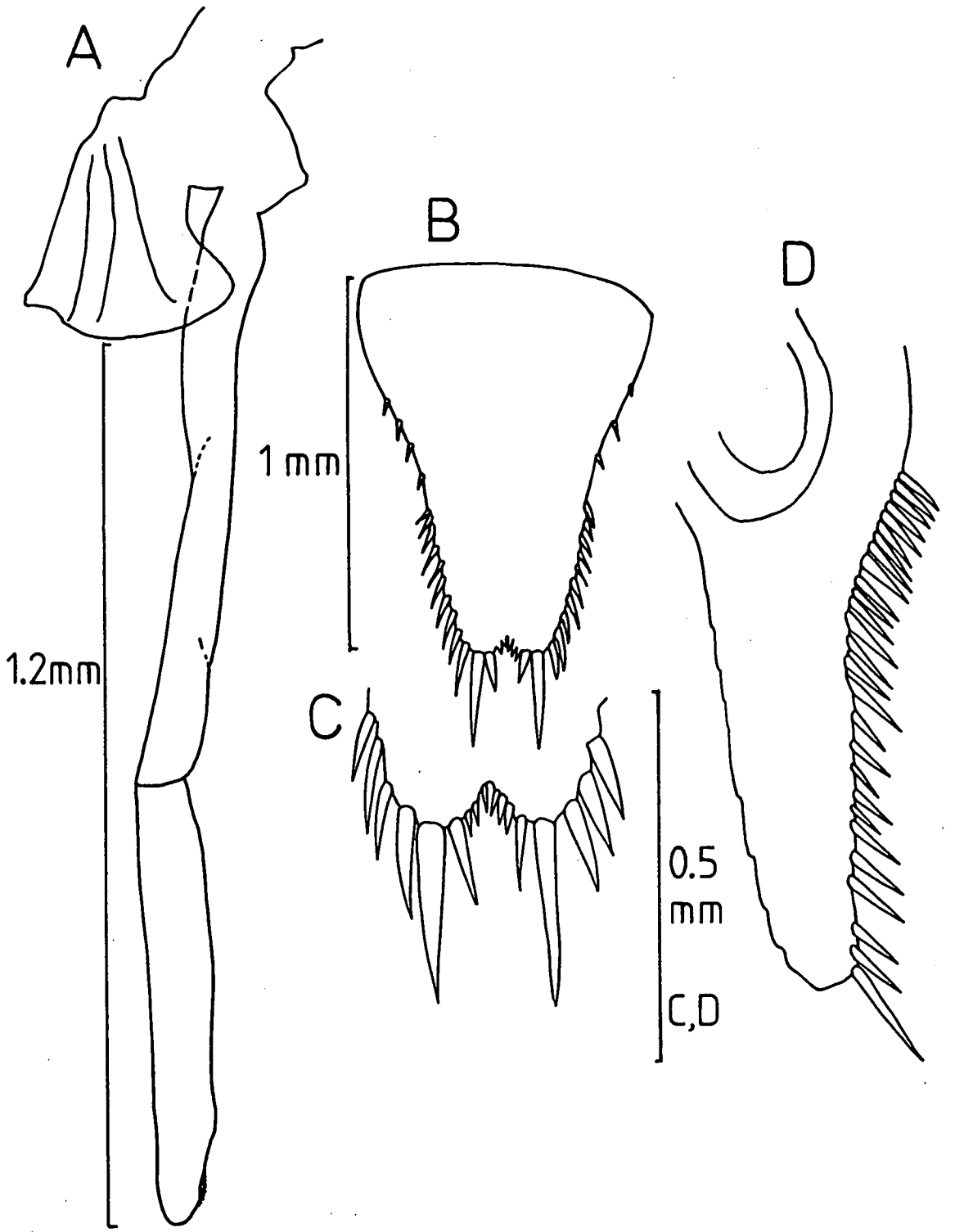
Known Distribution. Australia.

Australian Records.

1) National Museum of Victoria Bass Strait Survey: Stations 111, 115, 118, 156, 165, 184 and Q654.

Fig. 2.56 *Mysidella sp.1* n.sp.

A Genital appendage.
B Telson.
C Cleft of telson.
D Endopod of uropod.


A
B
D
1 mm
1.2mm
C
0.5
mm
C,D

2.4 SUMMARY

1. Mysid records in the literature were combined with the results obtained from the examination of museum collections and collections made during the present study to obtain a comprehensive list of the Australian species; 94 species and 38 genera have been recorded.

2. Illustrated keys for their identification are provided together with definitions for all taxa.

3. Distribution records are provided for all species, and numerous new Australian records have been given.

4. Three new genera, viz, Allomysis n.g., Paramesopodopsis n.g. and Tasmanomysis n.g. and twelve new species, viz, Allomysis sp.1 n.g. n.sp., Australomysis sp.1 n.sp., Doxomysis sp.1 n.sp., Haplostylus sp.1 n.sp., Iimysis sp.1 n.sp., Mysidella sp.1 n.sp., Paramesopodopsis rufa n.g. n.sp., Prionomysis sp.1 n.sp, Tasmanomysis oculata n.g. n.sp., Tenagomysis sp.1 n.sp., T.sp.2 n.sp. and T.sp.3 n.sp. have been described.

CHAPTER 3

BIOGEOGRAPHICAL RELATIONSHIPS OF THE AUSTRALIAN MYSIDS

3.1 INTRODUCTION

The study of mysid distributions in terms of their biogeographic relationships has been neglected in the past. This has been unavoidable because so little is known of species ranges. Mauchline (1980) however, has provided a useful discussion of the current knowledge of mysid species distributions. By far the majority of the species known, approximately 65%, live in shallow coastal waters; the remaining 35% inhabit the deep neritic or oceanic pelagic environments. World wide or cosmopolitan distributions (found in the Atlantic, Pacific and Indian Oceans) are seen in only a few species (Table 3.1), mainly those inhabiting the bathypelagic zone of the oceans where the water temperature is continuously cold (Mauchline, 1980; Wittmann, 1984). Only two species, Anchialina typica and Siriella thompsonii, which are considered as cosmopolitan, inhabit the epipelagic zone of the oceans. Most of the oceanic mysid species appear to be restricted to one ocean only, although there are, according to Mauchline (1980), about 12 species found in the Atlantic and Pacific Oceans and some 30 found in the Pacific and Indian Oceans.

Mysids, as with all peracarids, lack a free-swimming larval dispersal stage. Rather, the developing young are carried in the female brood pouch until their release as miniature adults. Consequently, in isolated areas there would be a strong pressure towards a high level of endemism (Barnard, 1972; Kensley, 1983). Since the majority of the mysid species known inhabit shallow coastal waters, it is hardly surprising to find restricted distributions; only those species capable of living in a range of habitats would be expected to show wider distributions.

The mysid faunas of many geographic areas including Australia and adjacent regions have only been partially investigated and documented. In fact Mauchline (1980) considered that only the mysid faunas of the north-east and north-west Atlantic Ocean, Caribbean Sea, Mediterranean Sea and Japanese region are well documented. Despite this the large number of species (n=94) and genera (n=38) known from Australian waters warrants some discussion of any affinities which might be present with neighbouring mysid faunas. Clearly, as further studies are undertaken to document the mysids

Table 3.1 Cosmopolitan species, found in the Atlantic, Pacific and Indian Oceans (Mauchline, 1980).

Anchialina typica	Eucopia sculpticauda
Arachnomysis leuckartii	Eucopia unguiculata
Caesaromysis hispida	Gnathophausia gigas
Euchaetomera glyphidophthalmica	Gnathophausia ingens
Euchaetomera tenuis	Gnathophausia zoea
Euchaetomera typica	Katerythrops oceanae
Euchaetomeropsis merolepis	Meterythrops picta
Eucopia australis	Petalophthalmus armiger
Eucopia grimaldii	Siriella thompsonii

of Australia and adjacent regions, the degree of similarity between various zones may change. Consequently any conclusions drawn from the present knowledge of the mysid fauna can only be regarded as preliminary.

The distributions of the Australian mysids are examined here; the locations are mapped and the species found in each of the marine biogeographic provinces of Australia [as defined by Knox (1963)] listed. In addition the distribution of species and genera are discussed in relation to world distributions within the zones previously defined by Mauchline and Murano (1977).

3.2 MATERIALS AND METHODS

3.2.1 WORLD MYSID RECORDS

The list of species and genera referred to as the "World List" combine only those species (n=785) and genera (n=125) listed in Mauchline (1980) and the Australian species (n=30) and genera (n=5) not included in that paper; the latter are listed in Appendix A1. Mysid records from outside Australian waters published after Mauchline (1980) have not been included. Distribution records provided by Mauchline and Murano (1977), Mauchline (1980) and those given in Chapter 2 have been combined to enable comparison of the Australian mysid fauna to that of neighbouring biogeographic zones. For this purpose the world zones defined by Mauchline and Murano (1977) have been adopted here (Fig. 3.1).

3.2.2 AUSTRALIAN MYSID RECORDS

Records of mysids in Australian waters have been obtained from a variety of sources, including records in the literature, examination of museum collections and collections made in Tasmanian waters. The methods employed to collect mysids in Tasmanian waters and details of the Bass Strait Survey are provided in Appendices A2 and A3. All the Australian mysid records are listed under the relevant species in Chapter 2.

3.2.3 AUSTRALIAN MARINE BIOGEOGRAPHIC PROVINCES

The Australian coastline has been divided into the following marine biogeographical provinces (Fig. 3.2) as defined by Knox (1963):

Tropical Provinces

1. Dampierian Province: extending from the Abrolhos Islands (28°50'S) on the Western Australian coast along the north-west and northern Australian coasts to the Torres Strait.

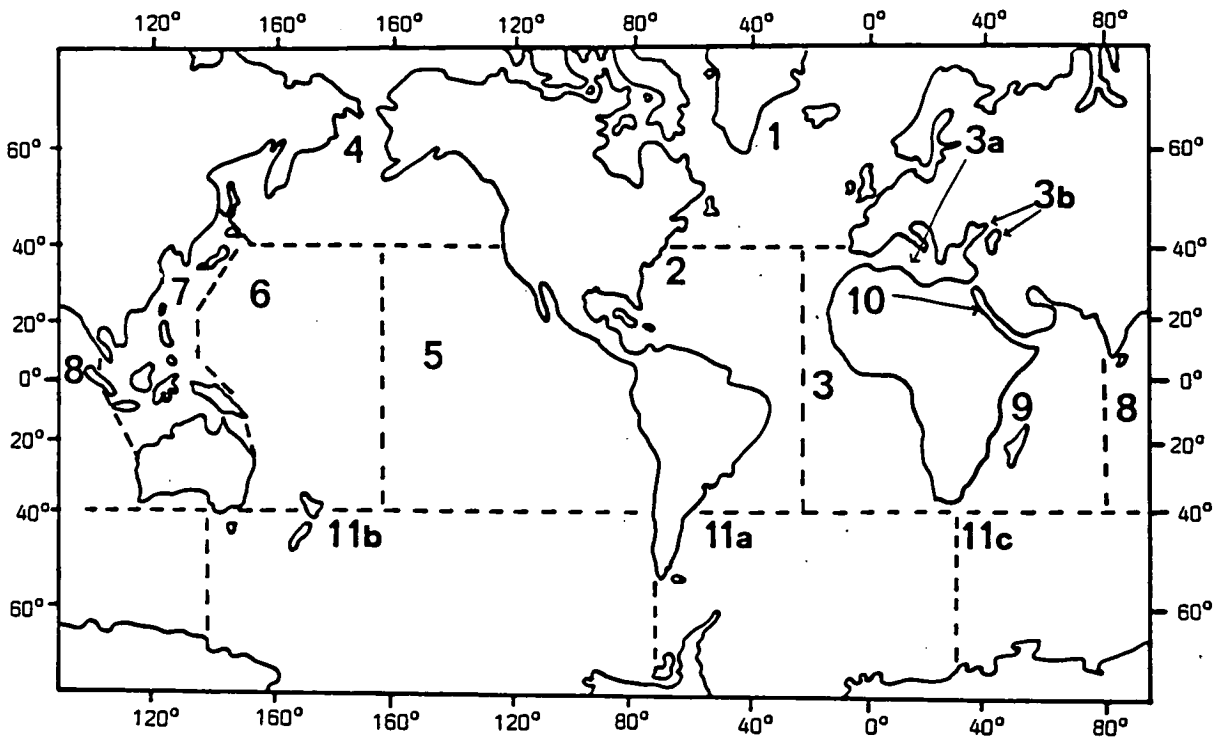


Fig. 3.1 World Zones as defined by Mauchline and Murano (1977). For convenience in the text these zones have been named as follows:

1= Northern Atlantic Ocean
2= Western Atlantic Ocean
3= Eastern Atlantic Ocean
3a= Mediterranean Sea
3b= Black and Caspian Seas
4= Northern Pacific Ocean
5= Eastern Pacific Ocean
6= Western Pacific Ocean
7= Indo-Malay Region
8= Eastern Indian Ocean
9= Western Indian Ocean
10= Red Sea
11a= Southern Atlantic Ocean
11b= Southern Pacific Ocean
11c= Southern Indian Ocean

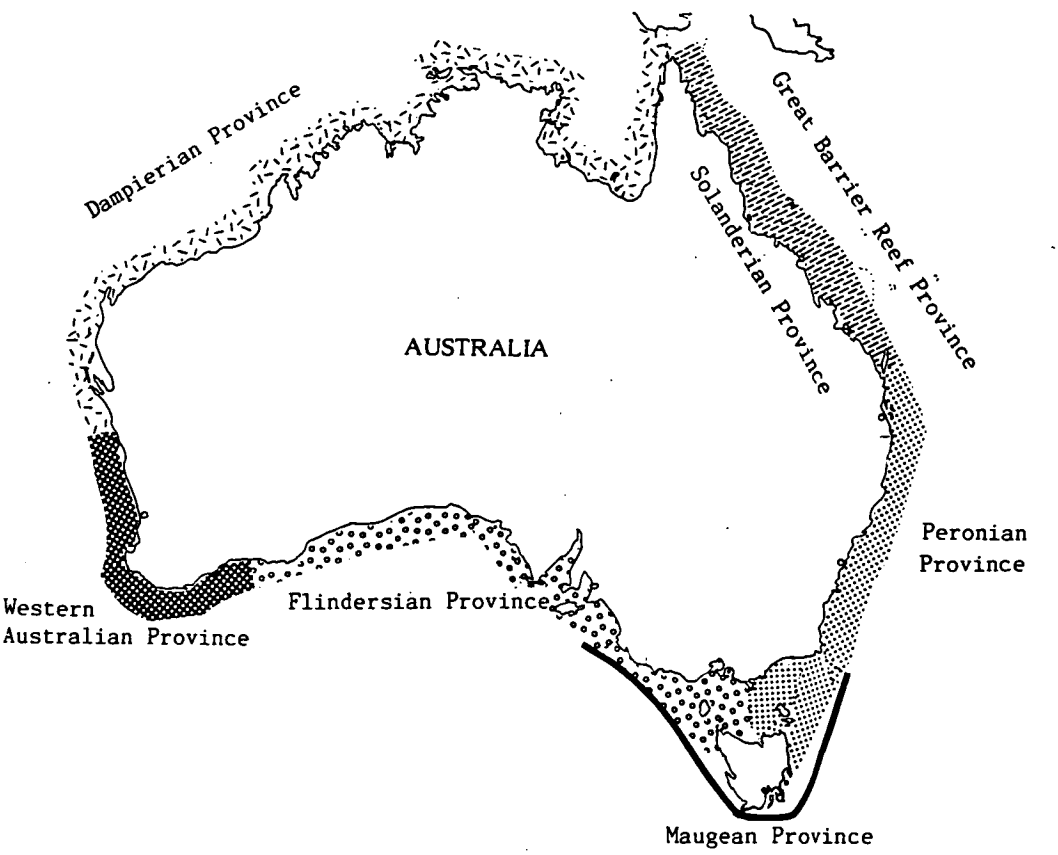


Fig. 3.2 Australian Marine Biogeographic Provinces (defined by Knox, 1963).

2. Solanderian Province: extending from the Torres Strait along the Queensland coast south to approximately 25°S in southern Queensland.
3. Great Barrier Reef Province: composed of the many islands and reefs of the Great Barrier Reef.

Warm Temperate Provinces

4. Western Australian Province: extending from the Abrolhos Islands (28°50'S) to the southern coast of Western Australia between Albany and Esperance.
5. Peronian Province: extending from south of 25°S down the coast of New South Wales and including an area of overlap in southern New South Wales and eastern Victoria.

Transitional Warm Temperate Province

6. Flindersian Province: extending from between Albany and Esperance in southern Western Australia to Robe in South Australia.

Cool Temperate Province

7. Maugean Province: extending eastward from Robe in South Australia, including the coasts of Victoria and Tasmania. There is considerable overlap with the Peronian and Flindersian Provinces.

3.3 RESULTS

3.3.1 GENERA

Examination of the genera known to occur in each world zone (Tables 3.2 & 3.3) indicates that the greatest number is found in zone 7 (Indo-Malay Region); approximately 50% more than the next highest number found in zones 1 (Northern Atlantic Ocean), 8 (Eastern Indian Ocean) and 9 (Western Indian Ocean). The diversity in the Indo-West Pacific region is evident from the number of genera known to occur in this region.

A total of 38 genera have been reported from Australian waters. This represents 29% of all genera known in the world (n=130). Eight of these genera are endemic to Australia viz, Allomysis n.g., Australerythrops, Australomysis, Halemysis, Leptomysis/Notomysis n.g. (Wittmann, pers. commun.), Paramesopodopsis n.g., Paranchialina and Tasmanomysis n.g. The world zones in which the genera known from Australia are found are listed in Table 3.4. All world zones have genera in common with Australia. Although, a greater number of genera are common to zones 7 (Indo-Malay Region), 8 (Eastern Indian Ocean), 11b (Southern Pacific Ocean), 9 (Western

Table 3.2 Total Number of Genera Known in each World Zone (in descending order).

Zone	7	1	8	9	2	3	5	3a	11b	4	6	11a	10	3b	11c
Number	73	48	46	44	38	34	33	33	32	29	24	17	14	13	10

Table 3.3 Number of Genera Known in each World Zone, excluding genera known only from the Australian sector of zones 6, 7, 8 and 11b (in descending order).

Zone	7	1	9	8	2	3	5	3a	4	6	11a	11b	10	3b	11c
Number	72	48	44	42	38	34	33	33	29	19	17	14	14	13	10

Table 3.4 Zones in which genera known from Australia are found.

ZONE 1: Northern Atlantic Ocean
Anchialina, Boreomysis, Erythrops, Euchaetomera, Gastrosaccus, Gnathophausia, Haplostylus, Heteromysis, Hypererythrops, Iimysis, Katerythrops, Mysidella, Mysidetes, Petalophthalmus, Pseudomma, Siriella
n=16

ZONE 2: Western Atlantic Ocean
Anchialina, Boreomysis, Erythrops, Gnathophausia, Heteromysis, Heteromysoides, Hypererythrops, Katerythrops, Mysidella, Petalophthalmus, Promysis, Siriella, Synerythrops
n=13

ZONE 3: Eastern Atlantic Ocean
Anchialina, Boreomysis, Erythrops, Euchaetomera, Euchaetomeropsis, Gastrosaccus, Gnathophausia, Haplostylus, Heteromysis, Heteromysoides, Hypererythrops, Katerythrops, Petalophthalmus, Rhopalophthalmus, Siriella
n=15

ZONE 3a: Mediterranean Sea
Anchialina, Boreomysis, Erythrops, Euchaetomera, Euchaetomeropsis, Gastrosaccus, Haplostylus, Heteromysis, Mysidella, Mysidetes, Pseudomma, Rhopalophthalmus, Siriella
n=13

ZONE 3b: Black and Caspian Seas
Gastrosaccus, Haplostylus, Siriella
n=3

ZONE 4: Northern Pacific Ocean
Boreomysis, Euchaetomeropsis, Gnathophausia, Mysidella, Petalophthalmus, Pseudomma
n=6

ZONE 5: Eastern Pacific Ocean
Anchialina, Boreomysis, Doxomysis, Euchaetomera, Euchaetomeropsis, Gnathophausia, Heteromysis, Mysidetes, Petalophthalmus, Siriella
n=10

ZONE 6: Western Pacific Ocean
Anchialina, Anisomysis, *Australerythrops, *Australomysis, Boreomysis, *Doxomysis, Euchaetomera, Gastrosaccus, Gnathophausia, Haplostylus, Hemisiriella, Heteromysis, *Idiomysis, Petalophthalmus, *Rhopalophthalmus, Siriella, Tenagomysis
n=17 (*=Australian sector record only, n=5)

ZONE 7: Indo-Malay Region
Anchialina, Anisomysis, Boreomysis, Doxomysis, Erythrops, Euchaetomera, Euchaetomeropsis, Gastrosaccus, Gibberythrops, Gnathophausia, Haplostylus, Hemisiriella, Heteromysis, *Heteromysoides, Hypererythrops, Idiomysis, Iimysis, Katerythrops, Mysidella, Petalophthalmus, Prionomysis, Promysis, Pseudanchialina, Pseudomma, Pseudomysidetes, Rhopalophthalmus, Siriella, Synerythrops
n=28 (*=Australian sector record only, n=1)

ZONE 8: Eastern Indian Ocean
Anchialina, Anisomysis, *Australomysis, Boreomysis, Doxomysis, Erythrops, Euchaetomera, Euchaetomeropsis, Gastrosaccus, Gibberythrops, Gnathophausia, *Halemysis, Haplostylus, Hemisiriella, Heteromysis, Hypererythrops, Idiomysis, Katerythrops, *Leptomysis/Notomysis n.g., *Paranchialina, Petalophthalmus, Prionomysis, Promysis, Pseudanchialina, Pseudomysidetes, Rhopalophthalmus, Siriella
n=27 (*=Australian sector record only, n=4)

Table 3.4 (cont.)

ZONE 9: Western Indian Ocean
Anchialina, Anisomysis, Boreomysis, Doxomysis, Erythrops, Euchaetomera, Gastrosaccus, Gibberythrops, Gnathophausia, Haplostylus, Hemisiriella, Heteromysis, Hypererythrops, Katerythrops, Petalophthalmus, Pseudanchialina, Promysis, Rhopalophthalmus, Siriella, Synerythrops
n=20

ZONE 10: Red Sea
Anisomysis, Boreomysis, Gibberythrops, Haplostylus, Heteromysis, Idiomysis, Pseudanchialina, Siriella
n=8

ZONE 11a: Southern Atlantic Ocean
Boreomysis, Euchaetomera, Gastrosaccus, Gnathophausia, Mysidetes, Pseudomma
n=6

ZONE 11b: Southern Pacific Ocean
*Allomysis n.g., *Anisomysis, *Australerythrops, *Australomysis, Boreomysis, *Doxomysis, Gnathophausia, *Haplostylus, *Heteromysis, *Iimysis, *Mysidella, Mysidetes, *Leptomysis/Notomysis n.g., *Paramesopodopsis, *Paranchialina, *Petalophthalmus, *Prionomysis, Pseudomma, *Pseudomysidetes, *Rhopalophthalmus, *Siriella, *Tasmanomysis, Tenagomysis
n=23 (*=Australian sector record only, n=18)

ZONE 11c: Southern Indian Ocean
Boreomysis, Euchaetomera, Gnathophausia, Mysidetes, Pseudomma
n=5

Indian Ocean) and 6 (Western Pacific Ocean) in descending order (Table 3.5), than in other world zones. However, many of the genera only occur within the Australian sector of zones 11b (Southern Pacific Ocean), 6 (Western Pacific Ocean), 8 (Eastern Indian Ocean) and 7 (Indo-Malay Region). Thus, by removing those genera known only by an Australian representative (Table 3.6) in these zones changes this order to zones 7 (Indo-Malay Region), 8 (Eastern Indian Ocean) and 9 (Western Indian Ocean) with zones 6 (Western Pacific Ocean) and particularly 11b (Southern Pacific Ocean) dropping well down the order, since over half of the genera in the latter region have only been recorded from the Australian sector of this zone.

Expressing the genera found in Australian waters as a percentage of the total number of genera known in each world zone (Table 3.7 and 3.8) shows that zones 11b (Southern Pacific Ocean) and 6 (Western Pacific Ocean) have a higher proportion of genera known from Australia than do zones 8 (Eastern Indian Ocean), 9 (Western Indian Ocean) and 7 (Indo-Malay Region) in descending order. However, removing the records of genera known only by an Australian representative in the zones bordering Australia, changes this order of zones to 6 (Western Pacific Ocean), 10 (Red Sea), 8 (Eastern Indian Ocean), 11c (Southern Indian Ocean), 9 (Western Indian Ocean), 3 (Eastern Atlantic Ocean), 3a (Mediterranean Sea), 7 (Indo-Malay Region), and 11b (Southern Pacific Ocean).

In summary, a greater number of genera found in Australian waters are also found in zones 7 (Indo-Malay Region), 8 (Eastern Indian Ocean) and 9 (Western Indian Ocean) than in other world zones. However, as a percentage of the total number of genera in each world zone, a higher percentage of the genera found in Australia are known to occur in zones 6 (Western Pacific Ocean), 10 (Red Sea), 8 (Eastern Indian Ocean), 11c (Southern Indian Ocean), 9 (Western Indian Ocean), 3 (Eastern Atlantic Ocean), 3a (Mediterranean Sea) than in zones 7 (Indo-Malay Region) and 11b (Southern Pacific Ocean).

3.3.2 SPECIES

Of the total number of species (n=815), 237 are known to occur in zone 7 (Indo-Malay Region), which is almost twice as many species as in zone 8 (Eastern Indian Ocean). Zone 7 clearly has the greatest diversity of mysids both in terms of genera and species. The number of species and the percentage they represent of the world total in each world zone is presented in Fig. 3.3.

There are 94 species recorded from Australia, representing 11.5% of

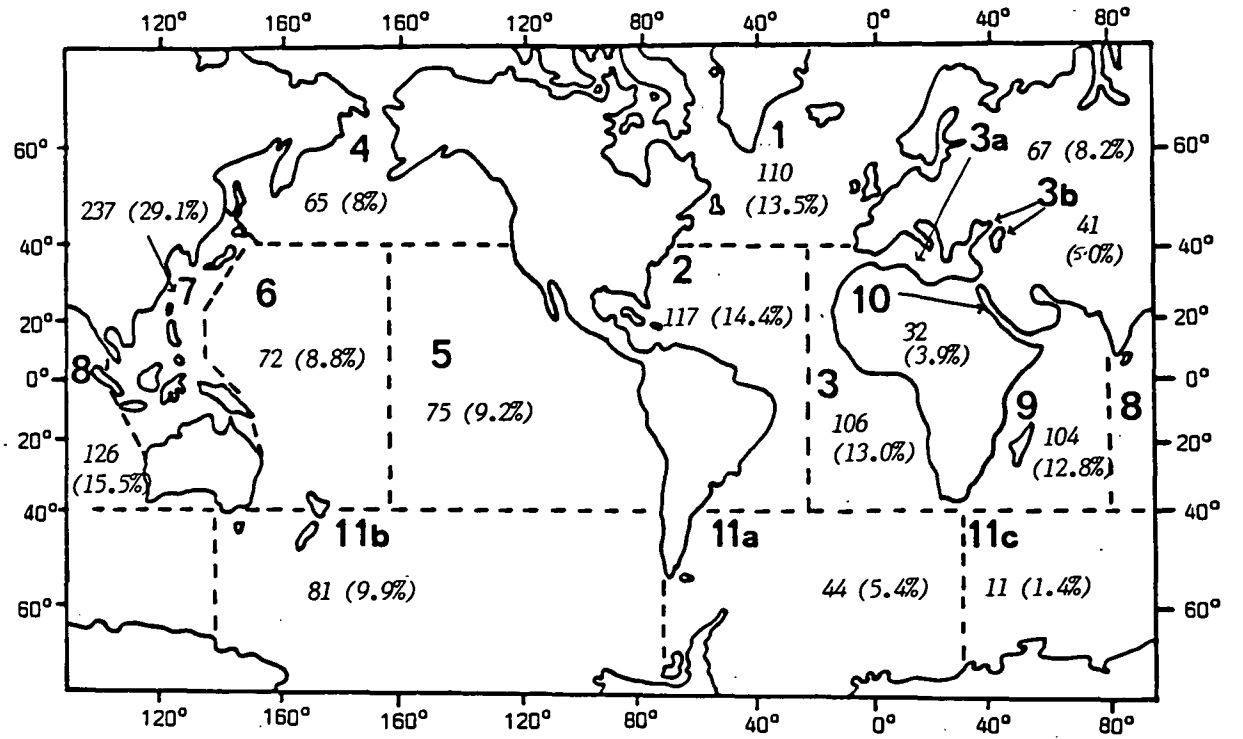


Fig. 3.3 Number and percentage of total species found in each world zone.

Table 3.5 Number of Genera Known from Australia in each Zone (in descending order).

Zone	7	8	11b	9	1	6	3	2	3a	5	10	11a	4	11c	3b
Number	28	27	23	20	16	16	15	13	13	10	8	6	6	5	3

Table 3.6 Number of Genera Known from Australia, excluding genera known only from the Australian sector of zones 6, 7, 8 and 11b in each Zone (in descending order).

Zone	7	8	9	1	3	2	3a	6	5	10	11a	4	11c	11b	3b
Number	27	23	20	16	15	13	13	11	10	8	6	6	5	5	3

Table 3.7 Percentage of Genera Known from Australia in each Zone (in descending order).

Zone	11b	6	8	10	11c	9	3	3a	7	11a	2	1	5	3b	4
Percentage	72	67	59	57	50	46	44	39	38	35	34	33	30	23	21

Table 3.8 Percentage of Genera Known from Australia in each Zone, excluding genera known only from the Australian sector in zones 6, 7, 8 and 11b (in descending order).

Zone	6	10	8	11c	9	3	3a	7	11b	11a	2	1	5	3b	4
Percentage	58	57	55	50	46	44	39	38	36	35	34	33	30	23	21

all species in the world. Half of the species known from Australia (n=47) are endemic. The distribution of the Australian species in the world zones are listed in Table 3.9.

No species are common to Australia and zones 3b (Black and Caspian Seas), 11a (Southern Atlantic Ocean) and 11c (Southern Indian Ocean). Species known from zones 1 (Northern Atlantic Ocean), 2 (Western Atlantic Ocean), 3 (Eastern Atlantic Ocean) and 3a (Mediterranean Sea) and Australia only include those regarded as cosmopolitan in their distribution. The only species found in zone 4 (Northern Pacific Ocean) and known from Australia is the bathypelagic species Boreomysis sibogae, which is also recorded from zones 7 (Indo-Malay Region), 9 (Western Indian Ocean) and 10 (Red Sea). Eight species found in zone 5 (Eastern Pacific) are also known from Australia, four are cosmopolitan in distribution and the other four are widely distributed, at least known from zones 7 (Indo-Malay Region) and 8 (Eastern Indian Ocean). The five species known from Australia and zone 10 (Red Sea) are also found in zones 7 (Indo-Malay Region) and 9 (Western Indian Ocean), and 4 of them are also known from zone 8 (Eastern Indian Ocean) (B.sibogae has not been recorded from zone 8).

The largest number of species known from Australia which occur in a zone without direct contact with the Australian coast, are found in zone 9 (Western Indian Ocean). Nineteen species are common to both; all are also known from zone 7 (Indo-Malay Region; although Doxomysis longiura is only known from the Australian sector of zone 7), and fourteen of them are also known from zone 8 (Eastern Indian Ocean). Of the nineteen species, only two, D.longiura and Heteromysis zeylanica, are coastal species; the remainder are epi- or bathypelagic, including four cosmopolitan species.

Zones 6 (Western Pacific Ocean), 7 (Indo-Malay Region), 8 (Eastern Indian Ocean) and 11b (Southern Pacific Ocean) all border on the Australian coast. One third of the species known from zone 6 (Western Pacific Ocean) have been recorded from the Australian sector (Peronian Province) of this zone (n=24). Twenty of these species (28%) are only known from the Australian sector of zone 6, and four species (6%) occur elsewhere in this zone. In addition, there are four species which, although they have not been recorded from the Australian sector of zone 6 (Western Pacific Ocean), they are known from other parts of the Australian coast.

Forty-seven species have been recorded from the Australian sector of zone 7 (Indo-Malay Region) i.e. Great Barrier Reef Province, which constitutes 20% of the total number of species (n=237) known to occur in this zone. Of the 47 species, 17 (7%) are known only from the Australian sector and 30 (13%) occur elsewhere within zone 7. There are also ten species from

Table 3.9 Distribution of Australian species in the World Zones.

ZONE 1: Northern Atlantic Ocean
Katerythrops oceanae
n=1

ZONE 2: Western Atlantic Ocean
Anchialina typica, Gnathophausia ingens, Katerythrops oceanae, Siriella thompsonii
n=4

ZONE 3: Eastern Atlantic Ocean
Anchialina typica, Euchaetomeropsis merolepis, Gnathophausia ingens, Katerythrops oceanae, Siriella thompsonii
n=5

ZONE 3a: Mediterranean Sea
Euchaetomeropsis merolepis
n=1

ZONE 3b
n=0

ZONE 4: Northern Pacific Ocean
Boreomysis sibogae
n=1

ZONE 5: Eastern Pacific Ocean
Anchialina typica, Doxomysis quadrispinosa, Euchaetomeropsis merolepis, Gnathophausia ingens, Siriella aequiremis, S.gracilis, S.thompsonii, S.vulgaris
n=8

ZONE 6: Western Pacific Ocean
Australian Record Only
Anisomysis mixta australis, Australerythrops paradicei, Australomysis incisa, Doxomysis australiensis, D.proxima, Gastrosaccus daviei, Haplostylus (G.) bengalensis, H.(G.)brisbanensis, H.(G.) dakini, H.(G.) indicus, H.(G.) queenslandensis, H.sp.1, Idiomysis inermis, Leptomysis (Notomysis) australiensis, Petalophthalmus australis, Rhopalophthalmus brisbanensis, R.dakini, Siriella australis, S.longidactyla, S.vincenti
n=20
Also Known Elsewhere in this Zone
Anchialina penicillata, Gnathophausia ingens, Haplostylus (G.) pacificus, Siriella thompsonii
n=4
Other
Anchialina grossa, A.typica, Anisomysis lamellicauda, Siriella nodosa
n=4

ZONE 7: Indo-Malay Region
Australian Record Only
Anisomysis lamellicauda, Doxomysis longiura, Heteromysis abrucei, H.australica, H.harpaxoides, H.heronensis, H.macrophthalma, H.stellata, H.tethysiana, H.zeylanica, Heteromysoides longiseta, Prionomysis stenolepis, Pseudomysidetes russelli, Rhopalophthalmus brisbanensis, R.dakini, Siriella bacescui, S.vincenti
n=17
Also Known Elsewhere in this Zone
Anchialina grossa, A.typica, A.zimmeri, Anisomysis incisa, A.laticauda, A.mixta australis, A.pelewensis, Doxomysis littoralis, Erythrops yongei, Gibberythrops stephensoni, Haplostylus (G.) indicus, H.(G.) pacificus, Hemisiriella parva, H.pulchra, Hypererythrops spinifera, Katerythrops oceanae, Pseudanchialina inermis, P.pusilla, Promysis orientalis, Siriella affinis, S.anomala, S.distinguenda, S.dubia, S.inornata, S.media, S.nodosa, S.quadrispinosa, S.thompsonii, S.vulgaris, Synerythrops intermedia
n=30

Table 3.9 (cont.)

ZONE 7 (CONT.)

Other
Anchialina dentata, A.penicillata, Anisomysis bipartoculata, Boreomysis sibogae, Doxomysis quadrispinosa, Euchaetomeropsis merolepis, Gnathophausia ingens, Haplostylus (G.) bengalensis, Siriella aequiremis, S.gracilis
n=10

ZONE 8: Eastern Indian Ocean
Australian Record Only
Anisomysis bipartoculata, A.gracilis, A.lamellicauda, A.mixta australis, A.robustispina, Australomysis acuta, A.incisa, Halemysis australiensis, Haplostylus (G.) dakini, Heteromysis tasmanica, H.waitei, Leptomysis (Notomysis) australiensis, Paranchialina angusta, Petalophthalmus australis, Siriella australis, S.halei, S.vincenti, Tenagomysis sp.1
n=18
Also Known Elsewhere in this Zone
Anchialina dentata, A.typica, A.hispida, Doxomysis littoralis, D.quadrispinosa, Euchaetomera sp., Euchaetomeropsis merolepis, Gnathophausia ingens, Hemisiriella parva, H.pulchra, Idiomysis inermis, Katerythrops oceanae, Promysis orientalis, Pseudanchialina inermis, P.pusilla, Siriella aequiremis, S.gracilis, S.thompsonii
n=18
Other
Anchialina grossa, A.penicillata, Haplostylus (G.) bengalensis, H.(G.) pacificus, Heteromysis zeylanica, Hypererythrops spinifera, Prionomysis stenolepis, Siriella dubia, S.quadrispinosa, S.vulgaris
n=10

ZONE 9: Western Indian Ocean
Anchialina dentata, A.typica, Boreomysis sibogae, Doxomysis longiura, D.quadrispinosa, Haplostylus (G.) indicus, Gnathophausia ingens, Hemisiriella parva, H.pulchra, Heteromysis zeylanica, Katerythrops oceanae, Promysis orientalis, Pseudanchialina inermis, P.pusilla, Siriella aequiremis, S.gracilis, S.thompsonii, S.vulgaris, Synerythrops intermedia
n=19

ZONE 10: Red Sea
Boreomysis sibogae, Pseudanchialina inermis, Siriella aequiremis, S.gracilis, S.thompsonii
n=5

ZONE 11a: Southern Atlantic Ocean
n=0

ZONE 11b: Southern Pacific Ocean
Australian Record Only
Allomysis n.g., Anisomysis mixta australis, Australerythrops paradicei, Australomysis acuta, A.incisa, A.sp.1, Doxomysis sp.1, Haplostylus (G.) indicus, H.(G.) sp.1, Heteromysis tasmanica, H.waitei, Iimysis sp.1, Leptomysis (Notomysis) australiensis, Mysidella sp.1, Mysidetes halope, Paramesopodopsis rufa, Paranchialina angusta, Petalophthalmus australis, Prionomysis sp.1, Pseudomma australe, Pseudomysidetes russelli, Rhopalophthalmus sp., Siriella australis, S.halei, S.vincenti, Tasmanomysis oculata, Tenagomysis sp.1, T. sp.2, T. sp.3
n=29
Also Known Elsewhere in this Zone
Boreomysis sibogae, Gnathophausia ingens
n=2

ZONE 11c: Southern Indian Ocean
n=0

zone 7 which are known elsewhere in Australia that have not been recorded from the Australian sector of this zone.

The species (n=36) known from the Australian sector of zone 8 (Eastern Indian Ocean) i.e. Dampierian, Western Australian and Flindersian Provinces, constitute 29% of the total number of species known in this zone (n=126). Of these thirty-six species, 20 (16%) are known only from the Australian sector of zone 8, and 16 (13%) occur elsewhere in the zone. In addition, there are ten species from zone 8 which, although they are not known from the Australian sector of zone 8, are known from other parts of the Australian coast.

Thirty-one species have been recorded from the Australian sector of zone 11b (Southern Pacific Ocean) i.e. Maugean Province, which represents 38% of the total number of species known from this zone (n=81). Only two species, Gnathophausia ingens and Boreomysis sibogae, are known to occur elsewhere in this zone; the remaining species are not known elsewhere in zone 11b. Links between the Australian sector of zone 11b and the rest of this zone are consequently weaker than might be expected considering that this zone borders on the Australian coast.

In summary, links between the mysid faunas of the Atlantic and Southern Oceans are therefore minimal at the species level. However, links are evident between the Pacific Ocean (zone 6), Indian Ocean (zone 8 and 9) and the Indo-Malay region (zone 7).

3.3.3 AUSTRALIAN MARINE BIOGEOGRAPHIC PROVINCES

Tropical Provinces

Of the three tropical provinces, mysids have only been collected in two; the Dampierian and Great Barrier Reef.

Dampierian Province

Only a small part of the Dampierian Province has been sampled for mysids and there are no records from littoral coastal sites. Thirteen species, of which there are no Australian endemics, have been recorded (Table 3.10) from the Dampierian Province (Fig. 3.4). Eight of these species are also known to occur in the Great Barrier Reef Province; the remaining species are known from Indo-Malay region (zone 7) and Indian Ocean (zones 8 and 9).

Great Barrier Reef Province

Half of the mysid species known from Australia have been recorded from the Great Barrier Reef Province (n=47; Table 3.11). This province

Table 3.10 Distribution of mysids in the Dampierian Province.

SPECIES	ENDEMIC TO PROVINCE	ENDEMIC TO AUSTRALIA	COSMO-POLITAN SPECIES	OTHER AUST. PROVINCE	ZONE 1	2	3	3a	3b	4	5	6	7	8	9	10	11a	11b	11c
Anchialina dentata	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
A.typica	-	-	+	GBR	-	+	+	-	-	-	+	+	+	+	+	-	-	-	-
Anisomysis hispida	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Doxomysis littoralis	-	-	-	GBR	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-
D.quadrispinosa	-	-	-	-	-	-	-	-	-	-	+	-	+	+	+	-	-	-	-
Euchaetomeropsis merolepis	-	-	+	-	-	-	+	+	-	-	+	-	+	+	-	-	-	-	-
Hemisiriella parva	-	-	-	GBR	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
H.pulchra	-	-	-	GBR	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
Promysis orientalis	-	-	-	GBR	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
Pseudanchialina inermis	-	-	-	GBR	-	-	-	-	-	-	-	-	+	+	+	+?	-	-	-
P.pusilla	-	-	-	GBR	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-
Siriella gracilis	-	-	-	WA	-	-	-	-	-	-	+	-	+	+	+	+	-	-	-
S.thompsonii	-	-	+	GBR, P, WA	-	+	+	-	-	-	+	+	+	+	+	+	-	-	-
Totals N=13	0	0	3	8 GBR 1 P 2 WA	0	2	3	1	0	0	5	2	12	13	10	2(3?)	0	0	0

Fig. 3.4 Dampierian and Western Australian Province Mysid Records.

Dampierian Province

1: Stations 235 & 240 (Pillai,1973): Hemisiriella pulchra, Pseudanchialina pusilla, Siriella gracilis.
2: Stations 217, 225, 236, 248 & 362 (Pillai,1973): Anchialina dentata, Hemisiriella pulchra, Promysis orientalis, Pseudanchialina inermis, P.pusilla, Siriella gracilis, S.thompsonii.
3: Station 251 (Pillai,1973): Siriella thompsonii
4: Stations 208, 218, 224 & 238 (Pillai,1973): Hemisiriella pulchra, Pseudanchialina inermis, Siriella gracilis, S.thompsonii.
5: Station 748 (Pillai,1973): Doxomysis quadrispinosa, Hemisiriella parva.
6: Stations 219, 237 & 380 (Pillai,1973): Anisomysis hispida, Doxomysis littoralis, Hemisiriella pulchra, Siriella thompsonii.
7: Station 790 (Pillai,1973): Siriella thompsonii.
8: Station 220 (Pillai,1973): Siriella gracilis.
9: Station 257 (Pillai,1973): Siriella thompsonii.
10: Station 207 (Pillai,1973): Anchialina typica.
11: Station 381 (Pillai,1973): Siriella gracilis.
Other: Euchaetomeropsis merolepis north of 29°S off Western Australia (Taniguchi, 1974)

Western Australian Province

1: Station 221 (Pillai,1973): Siriella thompsonii.
2: Petalophthalmus australis, Panampunnayil (1982)
3: Station 222 (Pillai,1973): Euchaetomera sp. (J)
4: Station 262 (Pillai,1973): Siriella aequiremis.
5: Station 204 (Pillai,1973): Siriella gracilis.
6, 7 & 8: Anisomysis bipartoculata, A.robustispina, A.gracilis, Panampunnayil (1984).
Other: Gnathophausia ingens, Katerythrops oceanae west of Perth W.A., Tattersall, 1955.

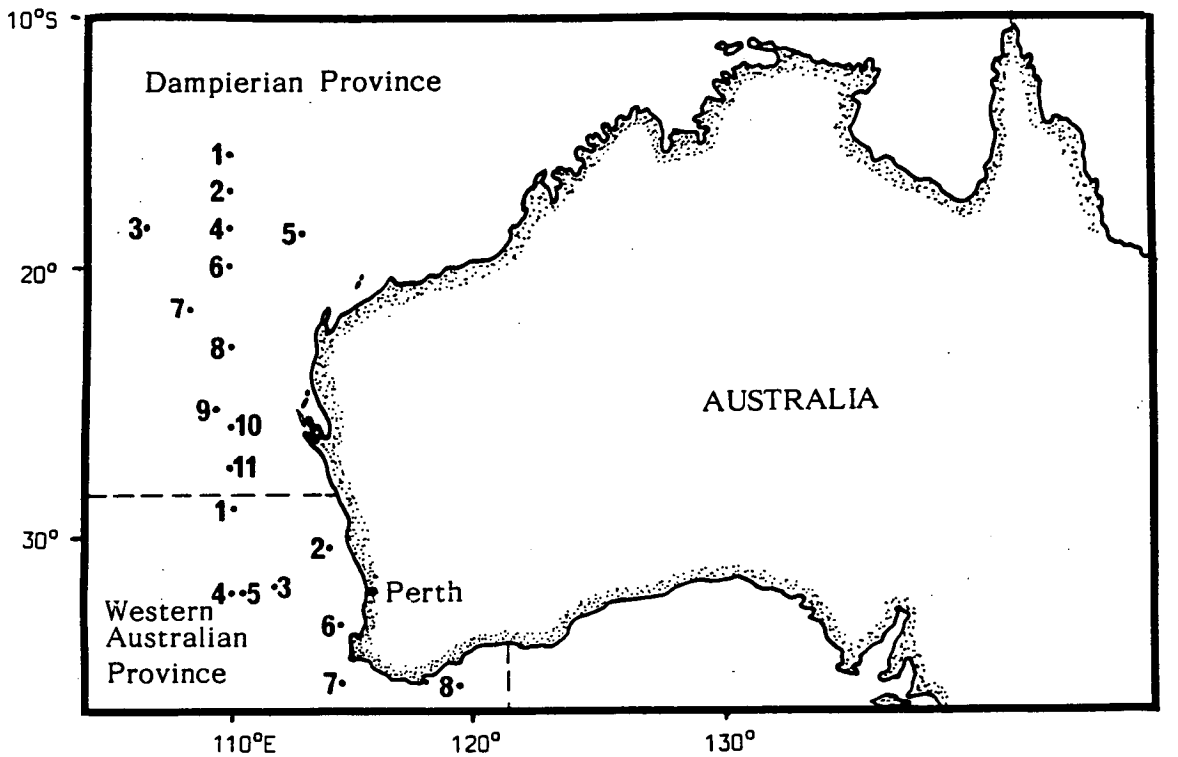

10°S
20°
30°
110°E
120°
130°
Dampierian Province
1
2
3
4
5
6
7
8
9
10
11
1
2
3
4
5
6
7
8
Perth
AUSTRALIA
Western
Australian
Province

Table 3.11 Distribution of mysids in the Great Barrier Reef Province.

SPECIES	ENDEMIC TO PROVINCE	ENDEMIC TO AUSTRALIA	COSMO-POLITAN SPECIES	OTHER AUST. PROVINCE	ZONE 1	2	3	3a	3b	4	5	6	7	8	9	10	11a	11b	11c
Anchialina grossa	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–
A.typica	–	–	+	D	–	+	+	–	–	–	+	+	+	+	+	–	–	–	–
A.zimmeri	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
Anisomysis incisa	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
A.lamellicauda	–	–	–	F?	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
A.laticauda	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
A.mixta australis	–	–	–	F, M, P	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
A.pelewensis	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
Doxomysis littoralis	–	–	–	D	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–
D.longiura	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–
Erythrops yongei	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
Gibberythrops stephensoni	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
Haplostylus (G.) indicus	–	–	–	M, P	–	–	–	–	–	–	–	–	+	–	+	–	–	–	–
H.(G.)pacificus	–	–	–	–	–	–	–	–	–	–	–	+	+	+	–	–	–	–	–
Hemisiriella parva	–	–	–	D	–	–	–	–	–	–	–	–	+	+	+	–	–	–	–
H.pulchra	–	–	–	D	–	–	–	–	–	–	–	–	+	+	+	–	–	–	–
Heteromysis abrucei	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H.australica	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H.harpaxoides	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H.heronensis	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

H.macrophthalma	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H.stellata	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H.tethysiana	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H.zeylanica	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–
Heteromysoides longiseta	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Hypererythrops spinifera	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–
Katerythrops oceanae?	–	–	+	WA	+	+	+	–	–	–	–	–	+	+	+	–	–	–	–
Prionomysis stenolepis	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–
Promysis orientalis	–	–	–	D	–	–	–	–	–	–	–	–	+	+	+	–	–	–	–
Pseudanchialina inermis	–	–	–	D	–	–	–	–	–	–	–	–	+	+	+	+?	–	–	–
P.pusilla	–	–	–	D	–	–	–	–	–	–	–	–	+	+	+	–	–	–	–
Pseudomysidetes russelli	–	+	–	M?	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rhopalophthalmus brisbanensis	–	+	–	P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
R.dakini	–	+	–	P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Siriella affinis	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
S.anomala	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
S.bacescui	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S.distinguenda	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
S.dubia	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–
S.inornata	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
S.media	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
S.nodosa	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–	–
S.quadrispinosa	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	–	–	–	–
S.thompsonii	–	–	+	D, P, WA	–	+	+	–	–	–	+	+	+	+	+	+	–	–	–
S.vincenti	–	+	–	F, M, P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 3.11 CTD.

SPECIES	ENDEMIC TO PROVINCE	ENDEMIC TO AUSTRALIA	COSMO-POLITAN SPECIES	OTHER AUST. PROVINCE	ZONE 1	2	3	3a	3b	4	5	6	7	8	9	10	11a	11b	11c
S.vulgaris	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	-	-
Synerythrops intermedia	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-
Totals N=47	9	13	3	8D 2(3?)F 3(4?)M 6 P 2 WA	1	3	3	0	0	0	2	7	28	17	12	2	0	0	0

N.B. i) The identification of Anisomysis lamellicauda from South Australia (Flindersian Province) and Pseudomysidetes russelli from Bass Strait (Maugean Province) are not positive. In both cases only a single damaged specimen was found in these provinces.
ii) The identification of Siriella vincenti from the Great Barrier Reef is based on a single juvenile specimen and that of Katerythrops sp? (possibly K.oceanae) from a single damaged specimen from the Great Barrier Reef (W.M. Tattersall, 1936). In both cases there is insufficient evidence to provide a positive identification from the Great Barrier Reef.

extends along the coast for nearly 2000km from Lady Elliot Island (lat. 24°5'S) to the Torres Strait and is recognized as the greatest system of coral reefs in the world. The mysids of only a very small proportion of this huge area have been examined. The sites at which mysids have been recorded are shown in Fig. 3.5.

Thirteen species endemic to Australia have been recorded from this province. Of these, nine, viz, Siriella bacescui, Heteromysis abrucei, H.australica, H.harpaxoides, H.heronensis, H.macrophthalmus, H.stellata, H.tethysiana and Heteromysoides longiseta are only known from the Great Barrier Reef Province. In fact, all these species were collected from the reefs surrounding Heron Island (S.bacescui from Benett Island, Chesterfield Group). The remaining four Australian endemic species, Rhopalophthalmus dakini, R.brisbanensis, Pseudomysidetes russelli and Siriella vincenti have also been recorded in other Australian provinces. However, the identification of S.vincenti from the Great Barrier Reef Province and that of P.russelli from Bass Strait were not positive and await future confirmation.

Thirty-four species found in this province are known from other world zones. Only 12 of these species have been found elsewhere in Australian waters, but all provinces have species in common with the Great Barrier Reef. The majority of the 34 non-endemic species are also found in zone 7 (Indo-Malay Region), and many also occur in zones 8 (Eastern Indian Ocean), 9 (Western Indian Ocean) and 6 (Western Pacific Ocean). Since the Great Barrier Reef Province itself lies in zone 7 (Indo-Malay Region), links with this zone are to be expected.

Warm Temperate Provinces

Western Australian Province

Ten mysid species are known from the Western Australian Province (Table 3.12 and Fig. 3.4), two, S.gracilis and the cosmopolitan species S.thompsonii are known from the adjoining Dampierian Province but none are found in the Flindersian Province. Three Australian endemic species have been recorded, namely, Petalophthalmus australis, Anisomysis gracilis and A.robustispina; the latter two are endemic to the Western Australian Province. Of the remaining seven species reported from this province three are cosmopolitan and four are known from zone 7 (Indo-Malay Region) and, with the exception of A.bipartoculata, are also found in zones 8 (Eastern Indian Ocean) and 9 (Western Indian Ocean).

Fig. 3.5 Great Barrier Reef Province Mysid Records.

Princess Charlotte Bay: Siriella inornata, S.vulgaris

Lizard Island: Siriella vincenti, Anchialina grossa, Haplostylus (G.) indicus, H.(G.)pacificus, Doxomysis littoralis, Prionomysis stenolepis, Anisomysis incisa, A.lamellicauda, A.laticauda, A.mixta australis, A.pelewensis.

Papuan Passage: Erythrops yongei

Low Isles: a) Low Isles :Doxomysis littoralis, D.longiura.

b) East of Low Isles: Hemisiriella parva, H.pulchra, Siriella anomala, S.dubia, S.thompsonii, S.vulgaris, Anchialina grossa, A.typica, Promysis orientalis.

c) Low Isles Flats: Siriella inornata, S.vulgaris, Pseudanchialina pusilla.

d) Barrier Reef Lagoon: Anchialina typica, Hyperythrops spinifera, Promysis orientalis, Anisomysis incisa.

e) Low Isles Anchorage: Siriella anomala, S.inornata, S.vulgaris, Anchialina grossa, Pseudanchialina pusilla, Doxomysis littoralis, D.longiura, Anisomysis incisa.

Trinity Opening: Rhopalophthalmus dakini, Hypererythrops spinifera, Katerythrops oceanae?, Gibberythrops stephensoni, Synerythrops intermedia, Pseudomysidetes russelli.

Heron Island: Siriella affinis, S.distinguenda, S.inornata, S.media, S.nodosa, S.quadrispinosa, Rhopalophthalmus brisbanensis, Anchialina grossa, A.zimmeri, Haplostylus (G.) pacificus, Pseudanchialina inermis, Doxomysis littoralis, Heteromysis abrucei, H.australica, H.harpaxoides, H.heronensis, H.macrophthalma, H.stellata, H.tethysiana, H.zeylanica, Heteromysoides longiseta.

Other: Benett Island, Chesterfield Group (approx.160°E 17°S) Siriella bacescui

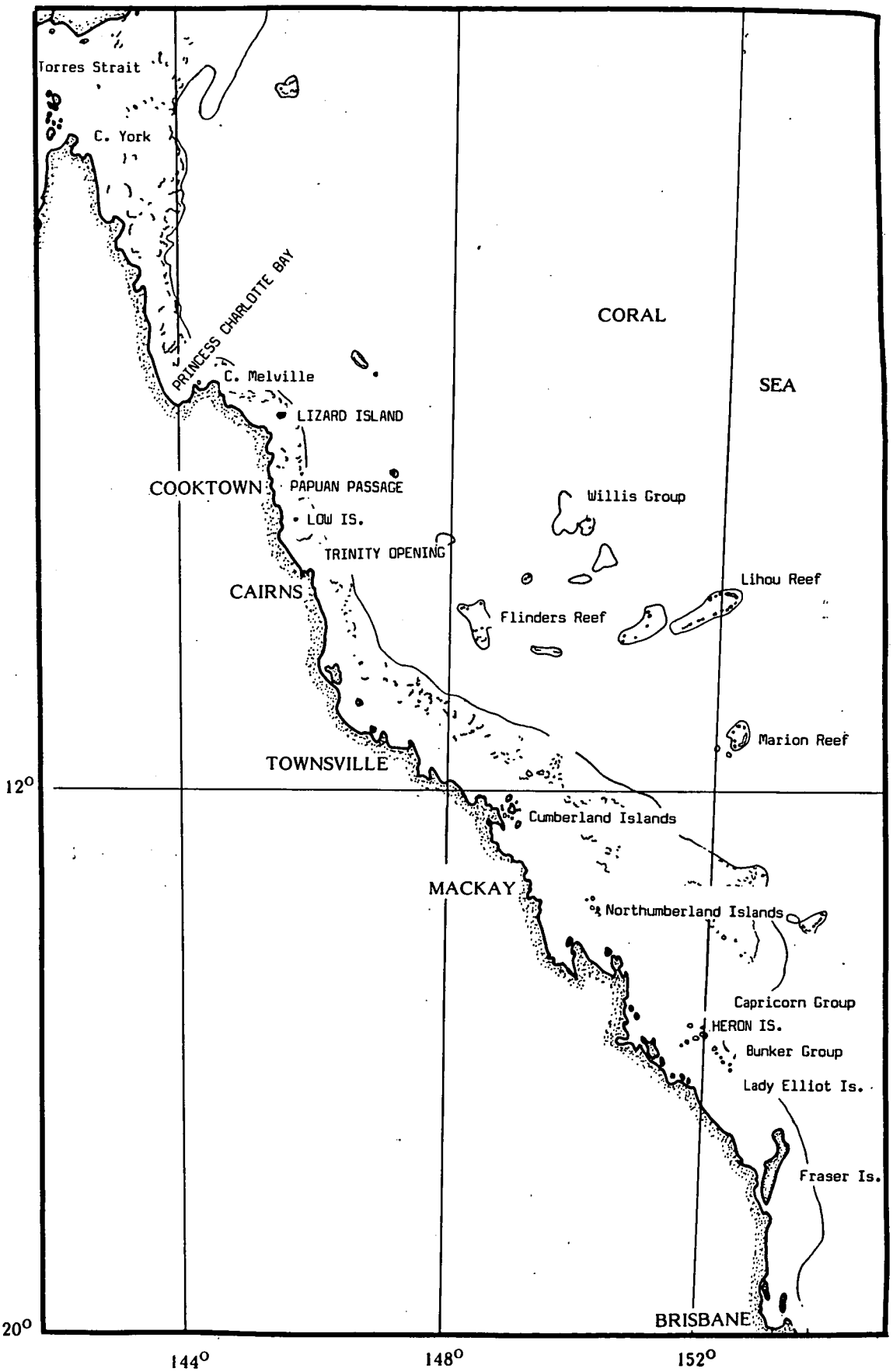

Torres Strait
C. York
PRINCESS CHARLOTTE BAY
C. Melville
LIZARD ISLAND
CORAL
SEA
COOKTOWN
PAPUAN PASSAGE
LOW IS.
TRINITY OPENING
Willis Group
Lihou Reef
CAIRNS
Flinders Reef
Marion Reef
TOWNSVILLE
12°
Cumberland Islands
MACKAY
Northumberland Islands
Capricorn Group
HERON IS.
Bunker Group
Lady Elliot Is.
Fraser Is.
BRISBANE
20°
144°
148°
152°

Table 3.12 Distribution of mysids in the Western Australian Province.

SPECIES	ENDEMIC TO PROVINCE	ENDEMIC TO AUSTRALIA	COSMO-POLITAN SPECIES	OTHER AUST. PROVINCE	ZONE 1	2	3	3a	3b	4	5	6	7	8	9	10	11a	11b	11c
Anisomysis bipartoculata	–	–	–	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
A.gracilis	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A.robustispina	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Euchaetomera sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Gnathophausia ingens	–	–	+	M, P	–	+	+	–	–	–	+	+	+	+	+	–	–	+	–
Katerythrops oceanae	–	–	+	GBR?	+	+	+	–	–	–	–	–	+	+	+	–	–	–	–
Petalophthalmus australis	–	+	–	M, P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Siriella aequiremis	–	–	–	–	–	–	–	–	–	–	+	–	+	+	+	+	–	–	–
S.gracilis	–	–	–	D	–	–	–	–	–	–	+	–	+	+	+	+	–	–	–
S.thompsonii	–	–	+	D, GBR, WA	–	+	+	–	–	–	+	+	+	+	+	+	–	–	–
Totals N=10	2	3	3	2 GBR 2 M 3 P 2 D	1	3	3	0	0	0	4	2	6	5	5	3	0	1	0

Peronian Province

The twenty-three species recorded from the Peronian Province include species from southern Queensland and the New South Wales coast (Table. 3.13). A map of localities is provided in Fig. 3.6, together with the species found at each site. Sixteen species, endemic to Australia, have been recorded from the Peronian Province. Of these, Doxomysis australiensis, D.proxima, Gastrosaccus daviei, Haplostylus (G.) brisbanensis, H.(G.)queenslandensis and Siriella longidactyla, are endemic to this province. Apart from the cosmopolitan species Siriella thompsonii, the seven species found in this province and which are known from other world zones are recorded from zones 7 (Indo-Malay Region), 8 (Eastern Indian Ocean), 6 (Western Pacific Ocean) and 9 (Western Indian Ocean). Two species, Anchialina penicillata and H.(G.)bengalensis, have not been recorded elsewhere in Australia.

Fifteen species known from the Peronian Province, are therefore found elsewhere in Australia. Seven are known from tropical waters, six are known from the Great Barrier Reef Province and one, the cosmopolitan species S.thompsonii, has been recorded from the Dampierian Province. In addition, eleven species are known from the warm temperate provinces, 10 from the Flindersian, 3 from the Western Australian and 10 from the cool-temperate Maugean Province.

Transitional Warm Temperate Province

Flindersian Province

Fifteen species have been recorded in the warm-temperate transitional Flindersian Province (Table 3.14), the majority from near Adelaide, South Australia. A map of sites sampled and species found in each is provided in Fig. 3.7. Only one species, Paranchialina angusta, has been collected from the Great Australian Bight. Twelve species are endemic to Australia; one, Halemysis australiensis, is at present known only from South Australia. The remaining three species have been recorded outside Australian waters; Idiomysis inermis known from Moreton Bay, Queensland and India (zone 8); Anisomysis mixta australis known from the Great Barrier Reef, New South Wales, Victoria, Tasmania and Japan (zone 7) as A.mixta; and Anisomysis lamellicauda known from the Great Barrier Reef Province and Fiji (zone 6). However, in the case of the latter species, a positive identification of the single damaged specimen from South Australia was not possible.

Table 3.13 Distribution of mysids in the Peronian Province.

SPECIES	ENDEMIC TO PROVINCE	ENDEMIC TO AUSTRALIA	COSMO-POLITAN SPECIES	OTHER AUST. PROVINCE	ZONE 1	2	3	3a	3b	4	5	6	7	8	9	10	11a	11b	11c
Anchialina pencillata	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-
Anisomysis mixta australis	-	-	-	GBR, F, M	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Australerythrops paradicei	-	+	-	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Australomysis incisa	-	+	-	F, M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Doxomysis australiensis	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D.proxima	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gastrosaccus daviei	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gnathophausia ingens	-	-	+	M, WA	-	+	+	-	-	-	+	+	+	+	+	-	-	+	-
Haplostylus (G.) bengalensis	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-
H.(G.)brisbanensis	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H.(G.)dakini	-	+	-	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H.(G.)indicus	-	-	-	GBR, M	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-
H.(G.)queenslandensis	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H.sp.1	-	+	-	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Idiomysis inermis	-	-	-	F	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Leptomysis australiensis	-	+	-	F, M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petalophthalmus australis	-	+	-	WA, M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Rhopalophthalmus brisbanensis	–	+	–	GBR	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
R.dakini	–	+	–	GBR	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Siriella australis	–	+	–	F, M	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S.longidactyla	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S.thompsonii	–	–	+	D, GBR, WA	–	+	+	–	–	–	+	+	+	+	+	+	–	–	–
S.vincenti	–	+	–	GBR, F, M	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Totals N=23	6	16	2	1 D 6 GBR 10 F 10 M 3 WA	0	2	2	0	0	0	2	3	6	5	3	1	0	1	0

Fig. 3.6 Peronian Province Mysid Records.

Brisbane River: Rhopalophthalmus brisbanensis, Haplostylus (G.) dakini, H.(G.)queenslandensis.

Moreton Bay: Gastrosaccus daviei, Haplostylus (G.) bengalensis, H.(G.)brisbanensis, Doxomysis australiensis, D.proxima, Idiomysis inermis, Australomysis incisa (?= Tenagomysis aseta).

Port Stephens: Siriella australis, S.longidactyla, Anchialina pencillata, Haplostylus (G.) indicus.

Broken Bay: Petalophthalmus australis, Siriella australis, S.vincenti, Haplostylus (G.) indicus, Australomysis incisa, Doxomysis australiensis, Leptomysis (Notomysis n.g.) australiensis.

Port Jackson: Australerythrops paradicei.

Port Hacking: Anisomysis mixta australis, Siriella australis.

Lake Illawarra: Haplostylus (G.) dakini, Rhopalophthalmus dakini.

Other:

Warm Core Eddy J: Siriella thompsonii.

Between Sydney and Auckland, New Zealand: Siriella thompsonii.

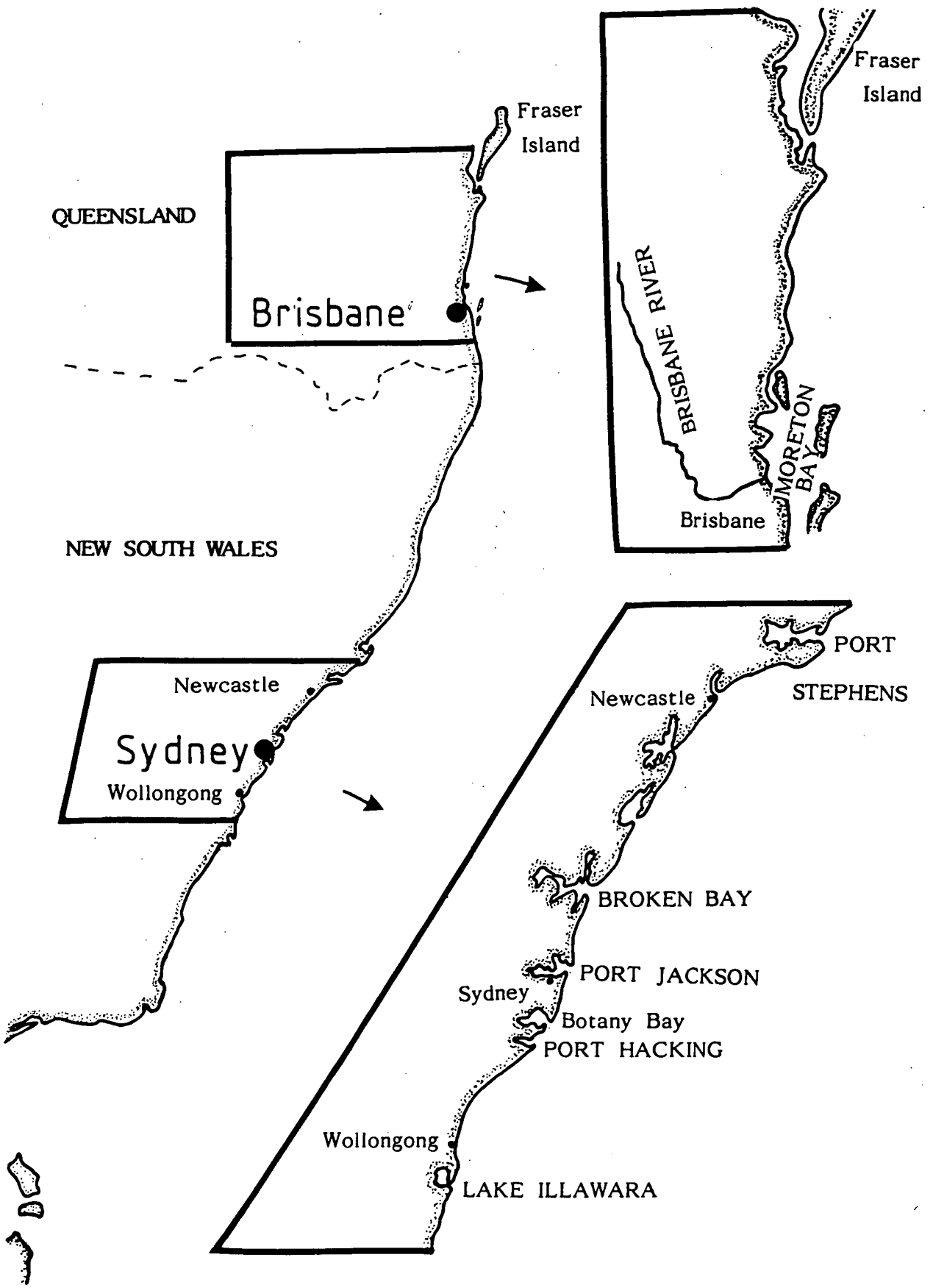

Fraser
Island
QUEENSLAND
Brisbane
NEW SOUTH WALES
Newcastle
Sydney
Wollongong
Fraser
Island
BRISBANE RIVER
MORETON
BAY
Brisbane
PORT
STEPHENS
Newcastle
BROKEN BAY
PORT JACKSON
Sydney
Botany Bay
PORT HACKING
Wollongong
LAKE ILLAWARA

Table 3.14 Distribution of mysids in the Flindersian Province.

SPECIES	ENDEMIC TO PROVINCE	ENDEMIC TO AUSTRALIA	COSMO-POLITAN SPECIES	OTHER AUST. PROVINCE	ZONE 1	2	3	3a	3b	4	5	6	7	8	9	10	11a	11b	11c
Anisomysis lamellicauda	–	–	–	GBR	–	–	–	–	–	–	–	+	–	–	–	–	–	–	–
A.mixta australis	–	–	–	GBR, M, P	–	–	–	–	–	–	–	–	+	–	–	–	–	–	–
Australomysis acuta	–	+	–	M	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
A.incisa	–	+	–	M, P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Halemysis australiensis	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Haplostylus (G.) dakini	–	+	–	P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Heteromysis tasmanica	–	+	–	M	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
H.waitei	–	+	–	M	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Idiomysis inermis	–	–	–	P	–	–	–	–	–	–	–	–	–	+	–	–	–	–	–
Leptomysis australiensis	–	+	–	M, P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Paranchialina angusta	–	+	–	M	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Siriella australis	–	+	–	M, P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S.halei	–	+	–	M	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S.vincenti	–	+	–	GBR, M, P	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Tenagomysis sp.1	–	+	–	M	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Totals	1	12	0	3 GBR 11 M 7 P	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0

Fig. 3.7 Flindersian Province Mysid Records.

Great Australian Bight: Paranchialina angusta

Port Lincoln: Halemysis australiensis

McLarens Point: Anisomysis lamellicauda

Thistle Island: Australomysis incisa

Reevsby Island: Leptomysis (Notomysis n.g.) australiensis

Port Pirie: Siriella australis, S.halei, Paranchialina angusta, Australomysis acuta

Edithburgh: Idiomysis inermis, Leptomysis (Notomysis n.g.) australiensis

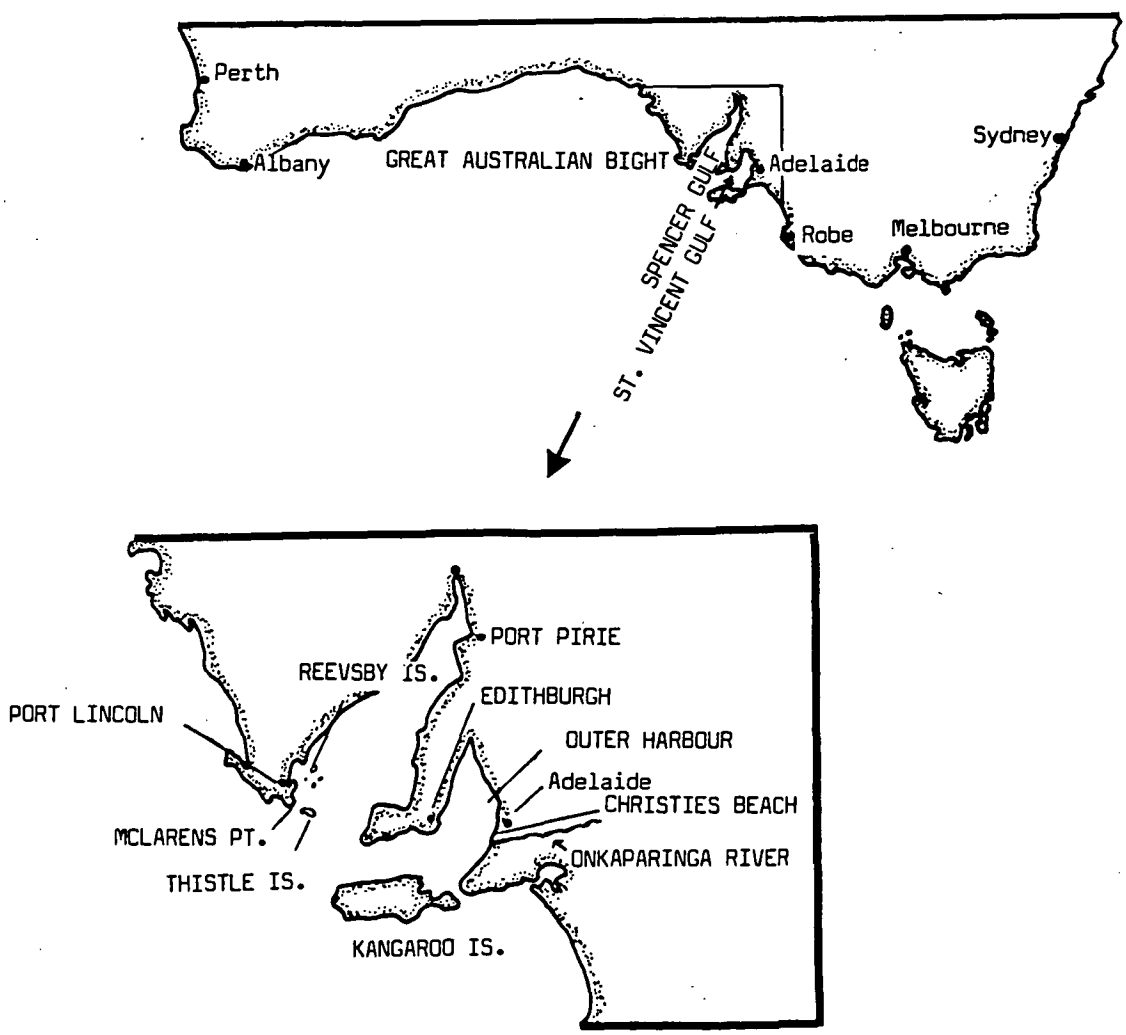
Outer Harbour: Paranchialina angusta, Australomysis acuta, Tenagomysis sp.1, Heteromysis waitei

Christies Beach: Halemysis australiensis

Onkaparinga River: H.(G.) dakini

Kangaroo Island: Siriella australis, Australomysis incisa, Anisomysis mixta australis

St. Vincents Gulf: Siriella australis, S.halei, S.vincenti, Petalophthalmus australis, Australomysis acuta, Leptomysis (Notomysis n.g.) australiensis, Heteromysis tasmanica, H.waitei


Perth
Albany
GREAT AUSTRALIAN BIGHT
SPENCER GULF
ST. VINCENT GULF
Adelaide
Robe
Melbourne
Sydney
PORT PIRIE
REEVSBY IS.
EDITHBURGH
PORT LINCOLN
OUTER HARBOUR
Adelaide
CHRISTIES BEACH
MCLARENS PT.
ONKAPARINGA RIVER
THISTLE IS.
KANGAROO IS.

Cool Temperate Province

Maugean Province

The cool-temperate Maugean Province includes records from Port Phillip Bay, Bass Strait and Tasmania (Table 3.15). Details of the sampling sites and species found for the Bass Strait survey and Tasmanian mysids are provided in Appendix A3 and A2, respectively. These results are summarized in regional terms in Fig. 3.8.

Thirty-one species have been collected; twenty-six are endemic to Australia, of which twelve are endemic to this province. Of the species endemic to this province, six are known only from Tasmania; Allomysis n.g. n.sp., Australomysis sp.1, Iimysis sp.1, Mysidetes halope, Tenagomysis sp.3 and Tasmanomysis oculata. A further two species, Mysidella sp.1 and Pseudomma australe have only been recorded from Bass Strait. Seven genera endemic to Australia have been recorded in this province including Leptomysis australiensis (as Notomysis n.g. Wittmann pers. commun), and two genera, viz Allomysis n.g. and Tasmanomysis n.g., have only been found in Tasmania.

Several species are also found in the Flindersian Province (n=11) and the Peronian Province (n=10). Five species, viz, A.mixta australis, Australomysis incisa, Leptomysis australiensis, Siriella australis and S.vincenti are known from all three temperate provinces. In addition, two species, A.mixta australis and H.(G.)indicus (or four including the doubtfully identified species Pseudomysidetes russelli and Siriella vincenti) are also known from the Great Barrier Reef Province, and two further species viz, Gnathophausia ingens and Petalophthalmus australis are known from the Western Australian Province.

Only four species, viz, A.mixta australis (as A.mixta), Boreomysis sibogae, G.ingens and H.G.indicus, have been recorded outside Australian waters. Both B.sibogae and the cosmopolitan species G.ingens are bathypelagic species which have been recorded elsewhere in zone 11b (Southern Pacific Ocean). A.mixta australis and H.(G.)indicus are both known from zone 7 (Indo-Malay Region) and H.(G.)indicus is also known from zone 9 (Western Indian Ocean).

3.4 DISCUSSION

Links between the mysid faunas of the Indian, Pacific and Southern Oceans would be expected by the geographic location of the Australian Continent and the patterns of ocean circulation in the Australasian region (Fig. 3.9). In particular, Australia has direct contact with the faunistically diverse tropical area, the Indo-West Pacific. The mysid fauna of

Table 3.15 Distribution of mysids in the Maugean Province.

SPECIES	ENDEMIC TO PROVINCE	ENDEMIC TO AUSTRALIA	COSMO-POLITAN SPECIES	OTHER AUST. PROVINCE	ZONE 1	2	3	3a	3b	4	5	6	7	8	9	10	11a	11b	11c
Allomysis n.g. sp.1	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anisomysis mixta australis	-	-	-	F, GBR, P	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Australerythrops paradicei	-	+	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Australomysis acuta	-	+	-	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A.incisa	-	+	-	F, P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
A.sp.1	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boreomysis sibogae	-	-	-	-	-	-	-	-	-	+	-	-	+	-	+	+	-	+	-
Doxomysis sp.1	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gnathophausia ingens	-	-	+	P, WA	-	+	+	-	-	-	+	+	+	+	+	-	-	+	-
Haplostylus (G.) indicus	-	-	-	GBR, P	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-
H.sp.1	-	+	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heteromysis tasmanica	-	+	-	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H.waitei	-	+	-	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iimysis sp.1	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leptomysis australiensis	-	+	-	F, P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mysidella sp.1	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mysidetes halope	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paramesopodopsis rufa	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paranchialina angusta	-	+	-	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Petalophthalmus australis	-	+	-	P, WA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prionomysis sp.1	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudomma australe	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudomysidetes russelli?	-	+	-	GBR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhopalophthalmus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siriella australis	-	+	-	F, P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S.halei	-	+	-	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S.vincenti	-	+	-	F, GBR, P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tasmanomysis oculata	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tenagomysis sp.1	-	+	-	F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T.sp.2	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T.sp.3	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals N=31	12	26	1	11 F 4(5?) GBR 10 P 2 WA	0	1	1	0	0	1	1	1	4	1	3	1	0	2	0

Fig. 3.8 Maugean Province Mysid Records.

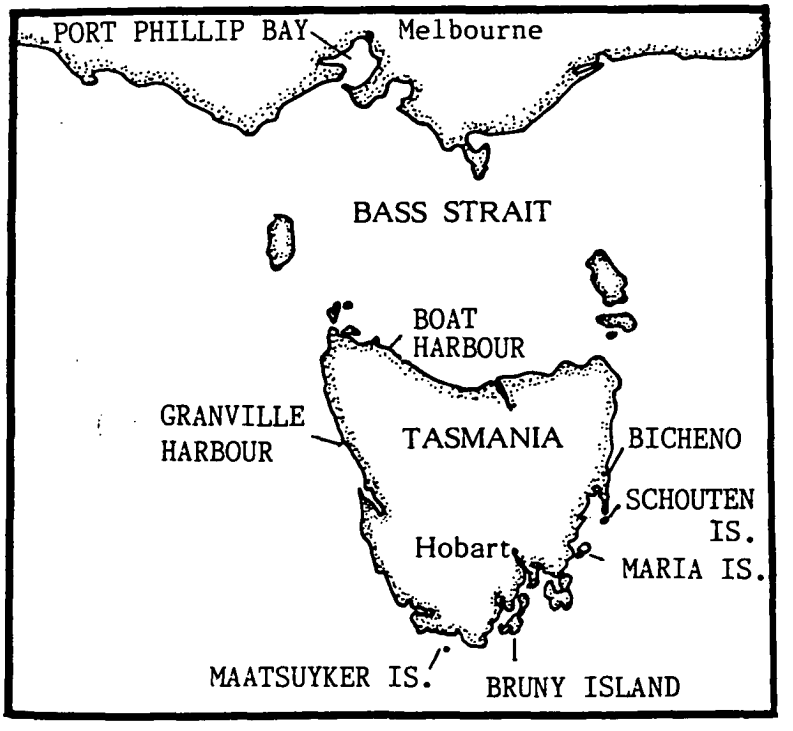
Victoria

Port Phillip Bay: Australomysis incisa, Anisomysis mixta australis, Pseudomma australe, Paranchialina angusta

Bass Strait (Stations detailed in Appendix A3)
Petalophthalmus australis, Rhopalophthalmus sp.1, Siriella australis, S.halei, S.vincenti, Haplostylus (G.) indicus, H.(G.)sp.1, Paranchialina angusta, Pseudomma australe, Australomysis acuta, A.incisa, Doxomysis sp.1, Leptomysis (Notomysis n.g.) australiensis, Prionomysis sp.1, Pseudomysidetes russelli, Tenagomysis sp.1, T.sp.2, Paramesopodopsis rufa, Heteromysis tasmanica, H.waitei, Mysidella sp.1

Tasmania

Boat Harbour: Paramesopodopsis rufa
Granville Harbour: Tenagomysis sp.1, Anisomysis mixta australis
Maatsuyker Island: Tenagomysis sp.1, Paramesopodopsis rufa
Bicheno: Australomysis sp.1
Schouten Island: Tenagomysis sp.2, Anisomysis mixta australis, Paramesopodopsis rufa
Maria Island: Boreomysis sibogae, Siriella vincenti, Paranchialina angusta
South-East Australia: (Sites detailed in Appendix A2) Siriella australis, S.vincenti, Haplostylus sp.1, Paranchialina angusta, Australerythrops paradicei, Allomysis n.g. sp.1, Australomysis acuta, A.incisa, Doxomysis sp.1, Iimysis sp.1, Leptomysis (Notomysis n.g.) australiensis, Mysidetes halope, Prionomysis sp.1, Tenagomysis sp.1, T.sp.2, T.sp.3, Anisomysis mixta australis, Paramesopodopsis rufa, Tasmanomysis oculata, Heteromysis tasmanica


PORT PHILLIP BAY
Melbourne
BASS STRAIT
BOAT
HARBOUR
GRANVILLE
HARBOUR
TASMANIA
BICHENO
SCHOUTEN
IS.
Hobart
MARIA IS.
MAATSUYKER IS.
BRUNY ISLAND

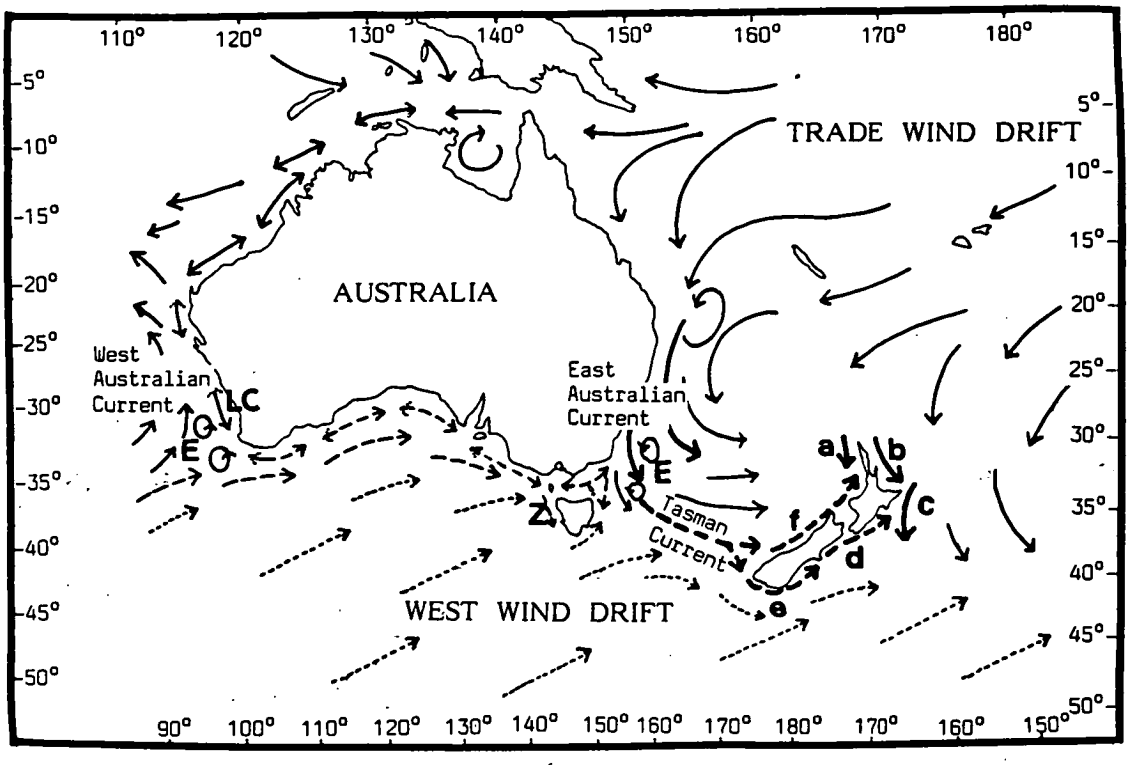


Fig. 3.9 Sea surface current circulation in Australasia (modified from Knox, 1963)

KEY:

↙ = Warm water currents

↙ = Mixed water currents

↙ = Cold water currents

↙ = Indicates reversal of flow at certain times

LC = Leeuwin Current

E = Eddy field

Z = Zeehan Current

New Zealand Currents:

a = West Auckland Current

b = East Auckland Current

c = East Cape Current

d = Canterbury Current

e = Southland Current

f = Westland Current

this area has already been shown (Section 3.3) to be rich in species and genera, especially zone 7 (which includes the Indo-Malay region, often regarded as the centre of the Indo-West Pacific), which exhibits a greater diversity than adjacent regions (Ekman, 1967; Briggs, 1974). Zone 7 alone has almost twice as many genera and species than any other single zone, but as Mauchline (1980) pointed out, much of this region has not been studied in detail, in fact only the Japanese waters are well documented.

Examination of the distribution of the Australian mysid fauna has shown strong links with the Indo-West Pacific. The Indo-West Pacific faunal element has been shown by Bennett and Pope (1960) and Knox (1963) to form the bulk of the shallow-water biota of Australia. For example, its importance is seen among the echinoderms (Clarke, 1946), portunid crabs (Stephenson, 1962), decapods (Griffin and Yaldwin, 1968) and alpheid shrimps (Banner and Banner, 1981) to name just a few. The links with the Indo-West Pacific are stronger among the tropical provinces of Australia than the temperate provinces. In fact, as Endean (1957) noted, the tropical fauna of Australia (Dampierian, Solanderian and Great Barrier Reef Provinces) is more closely related to that of the Indo-Malay region than to any other Australian province. Two main faunal groups have been recognized for decapods (Griffin and Yaldwin, 1968) and alpheid shrimps (Banner and Banner, 1981) in Australian waters; one of tropical species in Northern Australia and one of temperate species in Southern Australia with regions of overlap on the west and east coasts. This basic pattern is also observed for mysids.

Although there are three provinces distinguished within the Australian tropical region, several workers have questioned their validity (Endean et al.,1956; Womersley, 1981). Womersley (1981) considered that the entire tropical coast of Australia would be better treated as a single province, but conceded that sub-provinces may exist. The separation of the Dampierian from the Solanderian Province is based on the presence of the shallow waters of the Torres Strait. This Strait in a geological time-scale is a recent link between the Indian and Pacific Oceans. It is thought that this area was a land bridge between Australia and New Guinea from the Triassic until the Pleistocene, and that the sea flooded over the region forming the Torres Strait (10-20m depth) most probably between 6500-8000 years BP (Doutch, 1972). Markina (1976) concluded that the Torres Strait represented the biological boundary between the Pacific and Indian Oceans for planktonic species. In some ways this is surprising since the Strait has existed long enough for exchange to have occurred. Among the mysid species known to occur in the tropical provinces of Australia (Dampierian

and Great Barrier Reef Provinces) eight species are common to both. All of these species are widely distributed in the Indo-West Pacific and their presence in provinces on either side of the Torres Strait does not necessarily imply movement through the Torres Strait. There are no mysid records from the north-western and north coasts of Australia nor from the Torres Strait and mainland Queensland coast (Solanderian Province). Consequently, the validity of separating the tropical mysid fauna into provinces cannot be dealt with until extensive collections of mysids are made in this whole area.

There are nine species endemic to the tropical region of Australia (19% of Australian endemics); all have been recorded only from the Great Barrier Reef Province. Eight of these species belong to the Tribe Heteromysini and have only been recorded from the coral reefs of Heron Island. Bacescu (1983) believes that these coral reefs "represent a sector of adaptive radiation and speciation" for the genus Heteromysis similar to the situation observed in the Caribbean Sea. It should be emphasized that despite the fact that half of the mysid species recorded from Australia have been recorded from the Great Barrier Reef, only a very small proportion of the whole reef system has been sampled and many more species would be expected to occur there.

The west coast of Australia is unusual in that there is no cold-water current from the south; a feature observed on the west coast of Africa and South America which enables cool waters species to move northward and prevents the southward spread of tropical species. Instead, the Leeuwin Current which flows during autumn and winter down the coast of Western Australia (Fig. 3.9) (Cresswell and Golding, 1980; Rochford, 1984) brings tropical water of Pacific origin (Gentilli, 1972) down to the Great Australian Bight. Components of the tropical fauna are known to occur in the western half of the Bight (Maxwell and Cresswell, 1981; Markina 1976). It would be reasonable to expect considerable similarity between the mysid faunas of the Western Australian and Dampierian Province if a tropical fauna is present throughout this area. Mysids recorded from the Western Australian Province however, only include two species viz, S.gracilis and S.thompsonii known from the Dampierian Province. All the species known from the Dampierian Province have been recorded elsewhere in zone 8 (Eastern Indian Ocean) and most are also known from zones 7 (Indo-Malay Region) and 9 (Western Indian Ocean). Faunal links with the Indo-West Pacific (zones 7, 8 and 9) are evident in the Western Australian Province, but there are also three species endemic to Australia, whereas no endemic species have been recorded from the Dampierian province.

Similarities between the Western Australian Province and the Flindersian Province would also be expected on the basis of this current system, but there are no mysid species common to both. The separation of the West Australian region as a warm-temperate province by Knox (1963) appears justified, rather than combining it with the entire southern Australian coast as the Flindersian Province as suggested by Womersley (1981). It must be mentioned that the mysid faunas of the Western Australian and Dampierian Provinces are poorly known and do not include any records from shallow coastal habitats. The reverse situation is seen in the South Australian mysid records, so that it is likely that species common to both provinces will be found as further sampling is undertaken.

The tropical zone on the eastern seaboard of Australia is generally considered to end at about 25°S. However, the warm-temperate Peronian Province is influenced by the East-Australian current. This current brings warm tropical water southward from the Coral Sea (north of 28°S) along the east coast of Australia, and heads eastward away from the coast around 32°-36°S (Nilsson and Cresswell, 1981). Although a large number of mysids endemic to Australia are present (n=16), links with the Indo-West Pacific are evident (n=8). Most of the mysid species recorded from the Peronian Province are known from other Australian biogeographic regions, mainly from the temperate provinces, although a tropical influence is clear with six species also known to occur in the Great Barrier Reef Province. The presence of tropical species of molluscs and echinoderms, and a few coral zoanthids and tropical algae from the New South Wales coast, is testimony to the tropical influence in the Peronian Province (Bennett and Pope, 1953).

The warm-temperate transitional Flindersian Province is dominated by endemic mysid species and links with any other world zone are minimal i.e. restricted to zones 6 (Western Pacific Ocean), 7 (Indo-Malay Region) and 8 (Eastern Indian Ocean), with only a single species known from each. Links with tropical species appear weak. However, it is likely that the links with the Indo-West Pacific are stronger than indicated by the present mysid records, since tropical plankton species, benthic invertebrates and tropical pelagic tuna (Markina, 1976; Maxwell and Cresswell, 1981) have been reported from the Great Australian Bight. Presumably this occurs as a result of dispersal via the Leeuwin Current; in particular, numerous species of hydroid (Blackburn, 1942), echinoderms (Clark, 1946) and sea turtles (Houston, 1979) found in South Australia are known from the Indo-Pacific region. Many of the mysids found in the Flindersian Province also occur in both the Peronian and Maugean Provinces. Large areas of overlap

between these warm and cool temperate provinces have been recognized (Dartnall, 1974; Edgar, 1984). Sea-level changes during the Pleistocene ice-ages are held responsible for the separation of the Flindersian and Peronian Provinces (Dartnall, 1974; Edgar, 1984), since they resulted in the formation of an extensive land-bridge between Australia and Tasmania where Bass Strait now lies. The cold water around southern Tasmania at this time prevented movement of species between the east and west coasts which resulted in allopatric speciation, and enabled the development of a more diverse fauna to develop in southern Australia. Considerable overlap of distributions are observed now among species and sub-species pairs thought to have developed as a result of the Pleistocene separation (Dartnall, 1974).

The marine fauna and flora of the Tasmanian coast exhibits components of both Flindersian and Peronian Provinces. Five mysid species are found in all three Provinces and consequently exhibit a wide distribution. There are a similar number of species known from the Flindersian-Maugean and Peronian-Maugean Provinces. According to Edgar (1984), Bass Strait seems to be an area of overlap between the Flindersian and Maugean Provinces, but few Flindersian species extend further south. Recently, Baines et al. (1983) reported the existence of a southward flowing baroclinic current, the Zeehan current, over the continental slope of Western Bass Strait, down the west coast of Tasmania and indications are that it may reach the southern tip of Tasmania. This current, although of variable strength, appears to be a permanent feature. Its presence certainly has implications for the southward transport of organisms from the western edge of Bass Strait and the Flindersian Province.

Little is known of the mysid fauna from the west coast of Tasmania. Only Tenagomysis sp.1 and Anisomysis mixta australis have been recorded. Both species are also known from South Australia and Bass Strait. The species found in the Flindersian which are also known from the Maugean Province (n=11) have all (with the exception of Siriella halei, which is known from Bass Strait) been recorded from south-eastern Tasmania. A similar situation is seen between the species known from the Peronian and Maugean Provinces (n=10). Only, Haplostylus (G.) indicus and Petalophthlamus australis have not been recorded from south-eastern Tasmania. There are clearly several littoral species with a wide distribution range, presumably as a result of slow step-by-step dispersal. Examination of species habitat ranges is needed; particularly since many of the species found in shallow (2-4m) water in south-eastern Tasmania are found at considerable depth in Bass Strait (Appendix A2 & A3).

Although Tasmania lies in the path of the sub-tropical convergence (Wyrtki, 1960; Nyan Taw, 1975) and therefore is exposed to water masses of sub-antarctic and sub-tropical (presumably from the East Australian Current) origin, neither coast has been colonised by a true cold temperate fauna. The west coast of Tasmania is subjected to the West Wind Drift and some evidence of these cold waters reaching the coastline has been obtained from drift kelp from Kerguelen 4000km to the west and drift logs of South American Nothofagus (Dartnall, 1974). However, without direct contact with a truly cold-temperate fauna, there are few elements of the mysid fauna in Tasmania with any affinity to cold-water mysid faunas. Such links are only indicated at the genus level by the genus Mysidetes, [which is well represented in Antarctic waters and has only been collected from southern Tasmania in a marine coastal cave, (O'Brien, in press)] and the genus Pseudomma. Bathypelagic species such as G.ingens and B.sibogae cannot be regarded as evidence of links with a cold-water fauna. The new genus Tasmanomysis bears close similarities with two cold-temperate genera, Arthromysis, known from the Straits of Magellan, South America and Antarctomysis from the Antarctic Ocean. Nevertheless, a generic distinction is clear.

It would be reasonable to suggest that affinities between the mysid fauna of New Zealand and Australia may exist. Knox (1963) noted that similarities among many species of marine animals and plants existed between the two. However, Knox (1963; p. 364) stated that "as far as can be determined this transfer has been uni-directional from Australia to New Zealand". Transfer across the Tasman Sea would seem relatively straightforward for planktonic species or species with planktonic dispersal mechanisms, but mysids lack this mode of dispersal. Unfortunately, the mysid fauna of New Zealand is poorly known; Table 3.16 provides a list of New Zealand species. Only the cosmopolitan species Siriella thompsonii is known from Australia and New Zealand. However, the genera Tenagomysis (well represented in New Zealand with nine species), Siriella, Gastrosaccus, Pseudomma, Boreomysis and Euchaetomera have all been recorded from Australian waters. The only genus not known from Australia is the Lophogastrid Paralophogaster. Before comparisons between the New Zealand and Australian mysid fauna can take on any real meaning, the fauna of both zones needs to be examined in much fuller detail.

The Australian mysid fauna as a whole (n=94) includes 47 endemic species i.e. 50%. Separating the tropical provinces (n=9, 19%) from the temperate provinces (n=38, 81%) shows that endemism is greater in the temperate regions of Australia. The Australian mysid fauna has a strong

Table 3.16 New Zealand mysid species (Chilton, 1926; Bary, 1956). Endemic species are denoted by an asterix.

ORDER MYSIDACEA

Sub-order Lophogastrida

Paralophogaster glaber Hansen, 1910

Sub-order Mysida

Boreomysis rostrata Illig, 1906
Siriella thompsonii (M.-Edwards, 1837)
**S.denticulata* (Thomson, 1880)
**Gastrosaccus australis* W.M. Tattersall, 1923
Euchaetomera typica G.O. Sars, 1883
E.oculata Hansen, 1910
E.zurstrasseni (Illig, 1906)
**Tenagomysis novae-zealandiae* Thomson, 1900
**T.chiltoni* W.M. Tattersall, 1923
**T.similis* W.M. Tattersall, 1923
**T.macropis* W.M. Tattersall, 1923
**T.robusta* W.M. Tattersall, 1923
**T.producta* W.M. Tattersall, 1923
**T.scotti* W.M. Tattersall, 1923
**T.tenuipes* W.M. Tattersall, 1918
Pseudomma sp. Calman, 1908

affinity with that of the Indo-West Pacific and few links with temperate faunas of other world zones. There is enormous potential for investigation of mysids in Australia; so little of the coast has been examined and yet 94 species and 38 genera have been recorded. Many species known from neighbouring zones are likely to be found in Australian waters, particularly the remaining cosmopolitan species and many more species from the Indo-West Pacific.

3.5 SUMMARY

1. Thirty-eight genera and 94 species have been recorded from Australian waters, representing 29% and 11.5% of the total number of genera and species known in the world.

2. The distribution of mysid genera and species known from Australia have been examined here in relation to the world zones defined by Mauchline and Murano (1977) and the Australian marine biogeographic provinces defined by Knox (1963).

3. Eight genera and 47 species (50% of the Australian species) are endemic. These 8 endemic genera and 38 of the endemic species only occur in temperate Australia.

4. The Australian mysid fauna exhibits strong links with that of the Indo-West Pacific.

5. In general the distribution patterns of the Australian mysid fauna is similar to that found for other taxonomic groups in Australia, however, vast areas of the Australian coast have not been sampled for mysids so the findings presented here must be treated as preliminary.

PART B

ECOLOGY OF TASMANIAN COASTAL MYSIDS

CHAPTER 4

DISTRIBUTION AND POPULATION DYNAMICS

4.1 INTRODUCTION

Distribution of mysids, particularly in shallow water, intertidal, littoral and sub-littoral habitats, have shown zonation of species into well-defined bathymetric zones (Clutter, 1967, 1969; Mauchline, 1971e; Wittmann, 1977). Species living in such zones are frequently observed to have restricted distributions with populations occurring in a series of shoals (as defined by Mauchline, 1971e). Preference for certain substrates has been observed for many mysid species, often resulting in restricted distribution. For example, species may prefer sediment with a certain particle size (Maurer and Wigley, 1982) or associated with algae, sometimes with particular species of algae and some live as commensals with corals, sea anemones and hermit crabs (Mauchline, 1980). Wittmann (1977) observed that within a certain bathymetric zone, when more than one species is present, they inhabit different substrates and distinct microhabitats. In addition, activity patterns may be different; together these differences assist in maintaining monospecific shoals.

There are many mysid species which are known to shoal in shallow water; many are found shoaling throughout the year while a few only form breeding aggregations, remaining disaggregated most of the time (Mauchline, 1980). The main function of shoaling in those species which shoal continuously is probably not for breeding. Clutter (1969) and Zelickman (1974) discussed the probable functions of shoaling and suggested one reason may be to maintain the population in a particular zone of occurrence. Furthermore, and perhaps of primary importance, shoaling during the day may help to minimize predation from visual predators (Emery, 1968; Clutter, 1969). The suggestion that shoaling is an anti-predation mechanism is given further credence by the fact that shoals tend to disperse at night (Wittmann, 1977).

Diel activity rhythms have been found among many mysid species (Mauchline, 1980). Several species, including Gastrosaccus sanctus (Moran, 1972) G.mediterraneus, G.spinifer (Macquart-Moulin, 1977a) and G.psammodytes (Wooldridge, 1981) exhibit a pronounced diel activity pattern. During the day they remain within burrows but at night are planktonic. Mauchline (1980) lists numerous examples of species undergoing diel vertical

migration in the water column. The species rise to or at least towards the surface at night, but during the day they remain in close contact with the bottom. However, there are several species which do not perform vertical migrations (Mauchline, 1980). Although most of the species which have been examined show some form of diel activity rhythm, a few species, for example Leptomysis gracilis and Siriella jaltensis, do not (Mauchline, 1980).

The population dynamics of numerous epipelagic and coastal mysid species from tropical, sub-tropical, temperate and arctic regions have all shown seasonal peaks of abundance related to the timing of breeding, except for tropical species such as Mysidium columbiae (Goodbody, 1965). In general, the estuarine and littoral mysid species in temperate regions are most abundant during the warmer months i.e. warm-season breeders, and those occurring in Arctic or boreal climates exhibit maxima in autumn and winter i.e. cold-season breeders (Mauchline, 1980; Wittmann, 1984).

Several different life history patterns have been identified amongst mysid species, ranging from species which produce less than 0.5 generations per year, to species where more than three generations are produced in a year (Mauchline, 1980). Only one species, the bathypelagic Gnathophausia ingens, is known to produce less than 0.5 generations per year. According to Childress and Price (1978), G.ingens takes at least seven years to mature; the female carries only one brood in her lifetime (semelparous) which takes more than one year to develop within the marsupium. Mauchline (1980) suggested that the larger species inhabiting the deep neritic, meso- and bathypelagic zones have longer life cycles, often producing less than one generation per year.

The majority of the temperate littoral species examined so far produce three generations per year and the females are iteroparous (Mauchline, 1980; Wittmann 1984). In addition, there are a few species which appear to produce more than three generations per year, for example, Metamysidopsis elongata (Fager and Clutter, 1968). There are a few examples of species producing only one generation per year e.g. Mysis stenolepis (Amaratunga and Corey, 1975), M.mixta (Wigley and Burns, 1971), Mysidopsis didelphys (Mauchline, 1970b) and Schistomysis ornata (Mauchline, 1970a), or two generations per year eg. Praunus flexuosus (Mauchline, 1971c).

Despite numerous studies on the population dynamics of mysids, there are only a few from the Southern Hemisphere. Almeida Prado (1973) examined Bowmaniella brasiliensis, Brasilomysis castroi, Metamysidopsis elongata atlantica and Mysidopsis tortonsei from Brazil; Connell (1974) studied Mesopodopsis africana from South Africa (latitude 32°S); Wooldridge (1981) investigated the life history of the beach mysid Gastrosaccus

psammodytes also in South Africa (latitude 33°58'S). Only one study from Australia has been documented to date; Hodge (1963b) examined two estuarine species Gastrosaccus dakini and Rhopalophthalmus brisbanensis in the Brisbane River (latitude 27°S). The present study represents the southernmost study of mysids in Australia, and appears to be the only such study of a cool-temperate environment in the Southern Hemisphere reported in the literature.

The mysid population examined was that of a relatively isolated small coastal bay in southern Tasmania. In addition to analyzing the population dynamics throughout the year, three 24-hour sampling sessions were conducted; one in spring, summer and autumn. Fourteen species were found at the study site, nine of which are described in Chapter 2. The population structure of the monthly and 24-hour samples are presented in this chapter. The larval stages, estimate of production and examination of feeding relationships of these mysid species are examined in later chapters.

4.2 MATERIAL AND METHODS

4.2.1 STUDY SITE

The study site at One Tree Point, Bruny Island (Fig. 4.1A) is a small coastal bay on the northern side of the point, facing into Storm Bay. The bay is bordered on either side by rocks which are covered with macroalgae, and which slope to a sandy bottom, which is fairly homogenous across the bay. The beach is exposed to northerly and easterly weather throughout the year, and is frequently pounded by large waves and swell.

Three sampling transects i.e. A, B and C (Fig. 4.1B), were sampled each month over the 12 month period from September 1982 to August 1983 (Table 4.1). Each transect was approximately 70m long, extending outward from the beach through a depth range of 1.2m-6m.

4.2.2 TEMPERATURE AND SALINITY

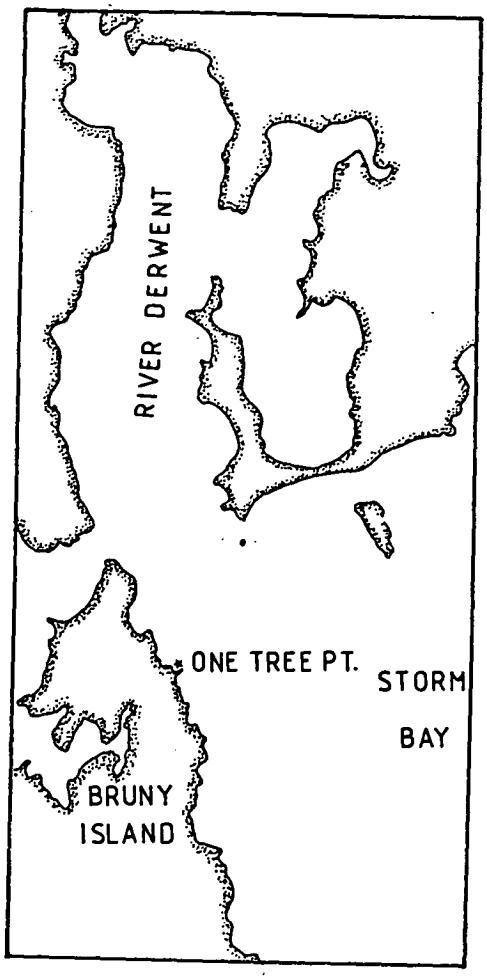
Water temperature and salinity were measured using a salinometer (Autolab model 602) for six months of the sampling period. Due to equipment failure in the other months, the data of Hosie (1982) collected at a site just outside the mouth of the bay at One Tree Point during 1980-1981 were used. This was thought to be justified since there was good correlation between the results obtained here and those of Hosie for temperature in months where temperature data were obtained at One Tree Point.

Fig. 4.1 The Study Site.

A) Location of the study area in south-eastern Tasmania.

B) Diagrammatic representation of the study area showing transects A, B and C. (Not drawn to scale)

A)


RIVER DERWENT
ONE TREE PT.
STORM
BAY
BRUNY
ISLAND

B)

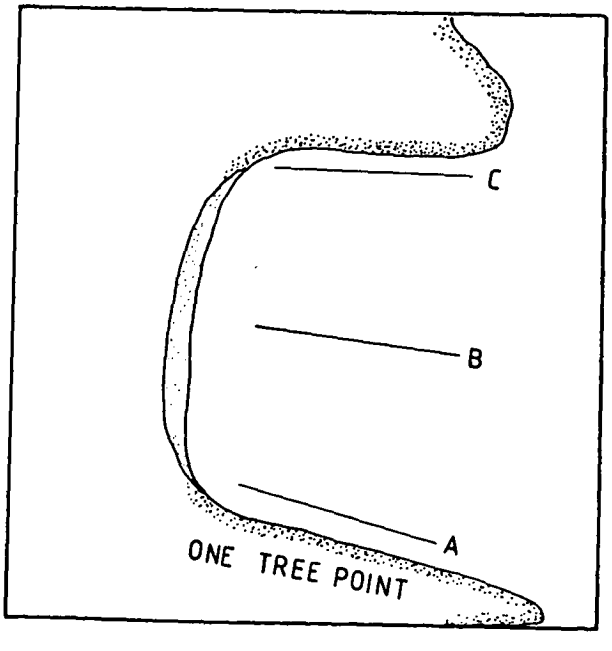

C
B
A
ONE TREE POINT

Table 4.1 One Tree Point sampling dates in 1982 and 1983.

1982

September 15th
October 11th-12th (24-hour Session)
November 19th
December 15th

1983

January 18th-19th (24-hour Session)
February 15th
March 9th
April 12th-13th (24-hour Session)
May 17th
June 15th
July 19th
August 11th

4.2.3 TIDES

Tidal information was obtained from the Marine Board Authority of Hobart tide tables for 1982 and 1983.

4.2.4 SEDIMENT ANALYSIS

Two samples of sediment, one in shallow (2m) water and the other in deep (4m), were collected by a SCUBA diver from each transect throughout the sampling period. Only the surface layer of the sediment was collected. This was achieved by skimming the surface 1-2cm of sediment with an open plastic bag. The six sediment samples collected in each month were analysed as follows to determine the percentage organic matter and the particle size composition.

4.2.4.1 Total Organic Content

The organic content of the sediment was determined by loss of weight on ignition at 475-480°C for 24h in a muffle furnace. According to Hirota and Szyper (1975) and Byers *et al.* (1978), calcium carbonate should not contribute to the weight loss as long as the temperature of combustion is maintained at or below 500°C. Approximately 10-15g samples of sediment were dried in a desiccator over silica-gel for a week (or until constant weight was achieved) prior to ignition.

4.2.4.2 Particle Size Analysis

A sample of oven dry sediment (80°C) weighing in excess of 100g was placed in a glass beaker or flask. To this about 250ml of tap water and 10ml of aqueous sodium hexametaphosphate [$(NaPO_3)_6$; $6.2gl^{-1}$) was added. The mixture was stirred vigorously with a glass rod for 10min, and then left to soak overnight. The following day the mixture was re-stirred as above and, after the sand settled, the supernatant was decanted. The sediment was then oven-dried for at least 48h at 80°C. A 100g sample was weighed and sieved through a series of sieves with mesh sizes 2.00mm, 1.00mm, 500µm, 250µm, 125µm and 63µm (Buchanan and Kain, 1971).

4.2.5 MYSID SAMPLING METHOD

Quantitative samples of mysids were collected each month by SCUBA diver using a hand-held FBA (Freshwater Biological Association) net, mesh size $1mm^2$. Each transect was sampled by the diver for a period of 3min; this corresponded to a distance of approximately 70m. It was estimated that the volume of water filtered in this time was $3.57m^3$. Mysid samples were returned to the research vessel and preserved immediately in 10% formalin.

The transect swum by the diver was constant throughout the sampling period, using underwater features as markers for start and finish. Mysid congregated in swarms at the edge of the algae-covered rock/sand interface at sites A and C; rarely more than 45cm above the substrate (only 1-2 mysids per transect was collected above this depth, as determined by daytime trials). The transect was defined such that the algae covered rocks, interface zone and sandy trough were sampled evenly. Throughout the net was maintained at approximately 5-10cm above the substrate, following the contours of the bottom.

Quantitative sampling of mysids by boat-deployed dredges proved impossible due to the underwater topography at sites A and C, where the dredge would snag on rocks and mysids would escape.

4.2.5.1 Monthly Collection

Mysid samples were collected between 1100-1300hrs each month. The sampling dates are listed in Table 4.1.

4.2.5.2 24-Hour Collection

Three 24-hour sampling sessions were conducted i.e. October, January and April. Quantitative samples of mysids were collected at 3 hourly intervals commencing at noon (1200 hrs). Samples were collected at each transect as for the monthly samples. Two divers worked together at all time for safety reasons. At night, one diver remained near the surface and followed the diver collecting the mysids keeping him in sight by use of a torch. In addition, the diver with the net also had a less powerful torch to minimize disturbance to the mysids. Four or five divers took part in each 24-hour session to share the work load.

In addition to the quantitative samples, a non-quantitative bulk collection of mysids at each site was made for gut contents analysis. Also a seine-net was dragged along the beach at 6-hourly intervals and the gut contents of all fish captured were examined. The results of the dietary analysis of mysids and their fish predators are discussed in Chapter 7.

It was originally planned to conduct a fourth 24-hour sampling session in July, however, rough weather prevented this (in 1983 and again in 1984). Although a monthly collection was made, the swell and wave action were considered too powerful for safe diving and manoeuvring the boat close to the rocks at night.

4.2.6 LABORATORY PROCEDURE

All species in the samples were sorted, counted and measured using a binocular microscope fitted with an ocular micrometer. At least 300

individuals in each sample were counted. The large samples were split using a Kott whirling sub-sampler (Kott, 1953; Wiborg, 1962). Total body length was measured, using an ocular micrometer, as length from the tip of the rostrum to the end of the exopod of the uropod excluding setae. For species identification and description see Chapter 2.

Males and females were easily recognized by the presence of penes or marsupium respectively. Individuals in which partial development of these features was evident were recorded as immature males and females. Those individuals that could not be sexed were juveniles (Mauchline, 1980). The number of young present in undamaged brood pouches was determined for all gravid females (see Chapter 5).

4.3 RESULTS

4.3.1 TEMPERATURE AND SALINITY

Temperature and salinity data for One Tree Point (depth 3-4m i.e. depth where mysids were collected) are plotted together with some data from Hosie (1982) in Figs. 4.2A and 4.2B. Little vertical stratification occurred at One Tree Point, but at SB9 (Hosie, 1982) differences occurred in most months between the surface and 3.5-7m depth (Appendix B1). Since the mysid species under investigation are not found in surface water, the values of temperature and salinity for a depth between 3.5 and 7m were used from Hosie's data.

4.3.2 SEDIMENT ANALYSIS

4.3.2.1 Total Organic Content

The organic content of the sediment collected from the shallow and deep station of each transect varied inconsistently during the year (Appendix B2). No significant difference was found between the organic content of the samples collected in shallow and deeper water at each site (site A: $t_{21}=0.04$, $p>0.9$; site B: $t_{22}=0.45$, $p>0.5$; site C: $t_{22}=0.08$, $p>0.9$). Mean monthly values for each site were calculated and plotted in Fig. 4.2C to show the seasonal variation. Organic content was highest during late spring and summer at all sites, and a second peak was observed during April and May at site A only. The total range of organic content for all sites was 0.57-2.96%.

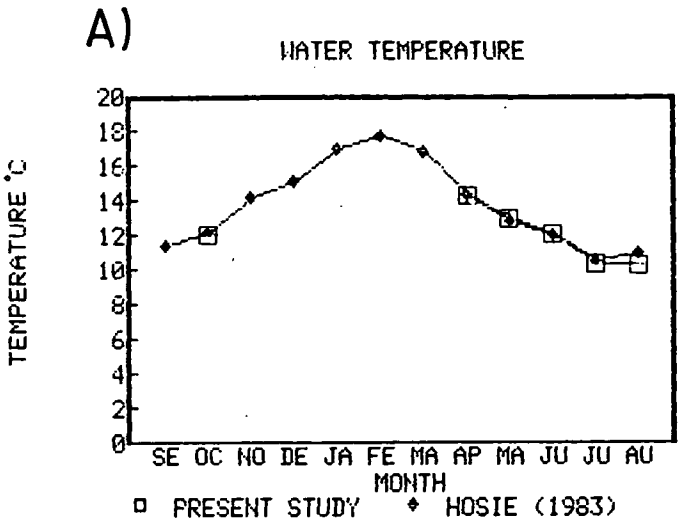
The annual mean organic content at site A ($\bar{x}=1.63\%$) was significantly ($t_{45}=2.52$, $p<0.02$) greater than at site C ($\bar{x}=1.08\%$); site B was intermediate ($\bar{x}=1.31\%$) and not significantly different from sites A or C ($t_{45}=1.39$, $p>0.1$ & $t_{46}=1.13$, $p>0.2$, respectively).

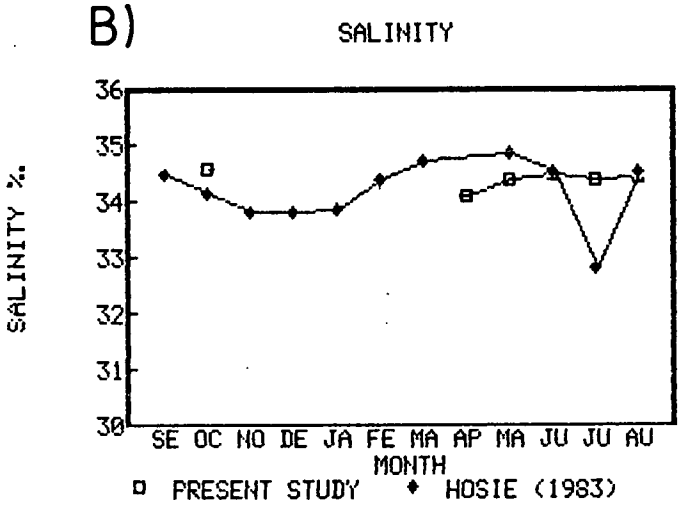
Fig. 4.2 Physical Charateristics of One Tree Point.

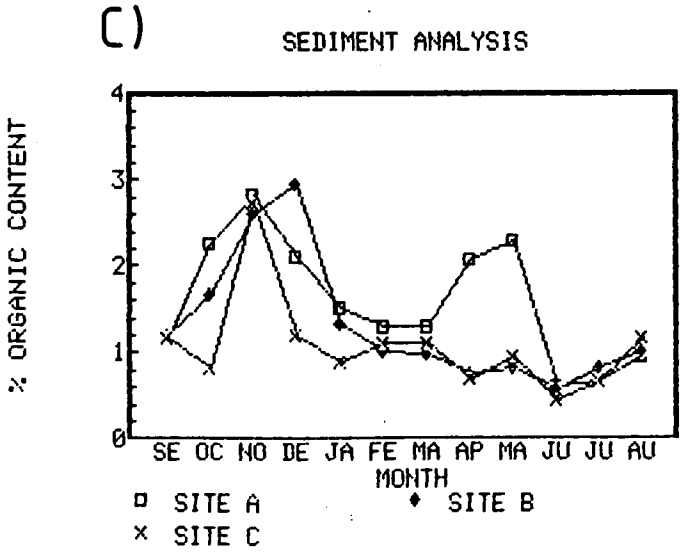
A) Water temperature (depth 3-4m) in 1982-1983 and including data from Hosie (1982).

B) Salinity (depth 3-4m) in 1982-1983 and including data from Hosie (1982).

C) Percentage of organic matter in sediment samples collected from each site throughout the study period.


A)
WATER TEMPERATURE
TEMPERATURE °C
20
18
16
14
12
10
8
6
4
2
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
PRESENT STUDY
HOSIE (1983)


B)
SALINITY
SALINITY ‰
36
35
34
33
32
31
30
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
PRESENT STUDY
HOSIE (1983)


C)
SEDIMENT ANALYSIS
% ORGANIC CONTENT
4
3
2
1
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
SITE A
SITE B
SITE C

4.3.2.2 Particle Size Analysis

Only slight variation was observed in the particle size composition from month to month (Appendix B3). Annual mean values were calculated for each site and are plotted in Fig. 4.3. During October at site A (deep) and in September at site C slightly more shell (>2.00mm) was present in the sediment samples. The results of the substrate analysis are provided in Table 4.2. The sediment at all sites was composed of well sorted fine sand. Low skewness values indicate no preferential sorting of the particle sizes (Morgans, 1956; Buchanan and Kain, 1971).

4.3.3 SPECIES

A total of 14 mysid species were collected from One Tree Point:

Sub-family Siriellinae
- *Siriella australis*

Sub-family Gastrosaccinae
- *Haplostylus sp.1* n.sp.

Sub-family Mysinae

Tribe Leptomysini
- *Allomysis sp.1* n.g. n.sp.
- *Australomysis acuta*
- *A.incisa*
- *Doxomysis sp.1* n.sp.
- *Iimysis sp.1* n.sp.
- *Leptomysis (Notomysis) australiensis*
- *Prionomysis sp.1* n.sp.
- *Tenagomysis sp.1* n.sp.
- *T.sp.2* n.sp.

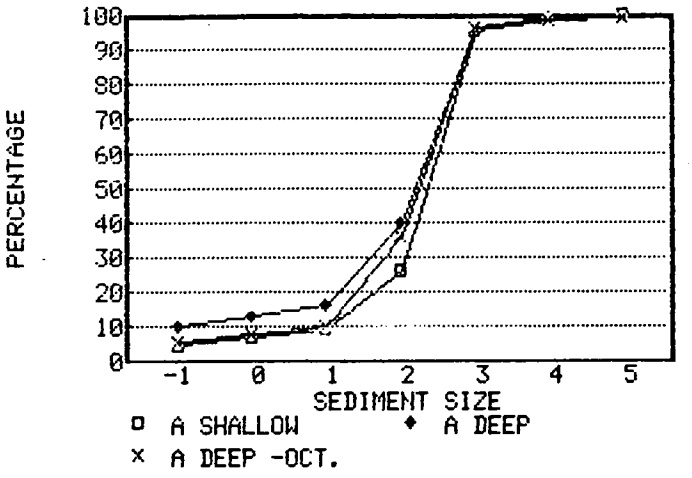
Tribe Mysini
- *Anisomysis mixta australis*
- *Paramesopodopsis rufa* n.g. n.sp.
- *Tasmanomysis oculata* n.g. n.sp.

Three species, *T.sp.2*, *A.mixta australis* and *P.rufa* dominated the mysid population in terms of numbers (Fig. 4.4A). They were present throughout the year forming conspicuous shoals. *T.sp.1* was the next most frequently caught mysid (9/12 months), although only one individual was caught in October and March (Fig. 4.4B). The other species were caught less frequently, and in lower numbers (Table 4.3). Of the less common mysid species collected, *Australomyis acuta* was collected in 8 of the 12 months

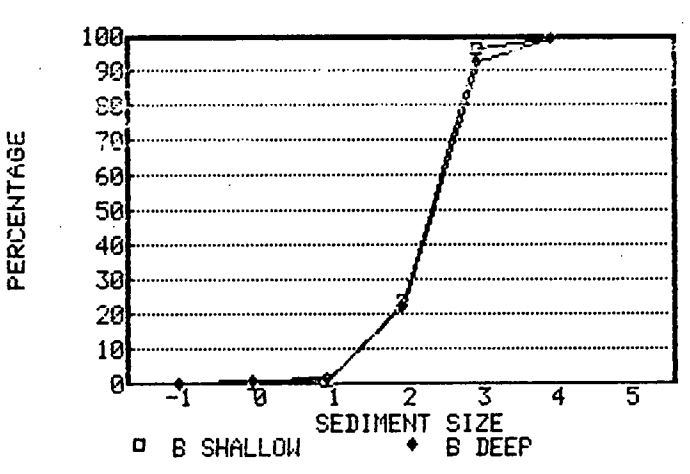
Fig. 4.3 Cumulative curve of the annual mean particle size distribution of sediment (phi-scale) collected at each site at One Tree Point.

A) Site A
B) Site B
C) Site C

A)


SEDIMENT SITE A
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
-1
0
1
2
3
4
5
SEDIMENT SIZE
A SHALLOW
A DEEP
A DEEP -OCT.

B)


SEDIMENT SITE B
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
-1
0
1
2
3
4
5
SEDIMENT SIZE
B SHALLOW
B DEEP

C)

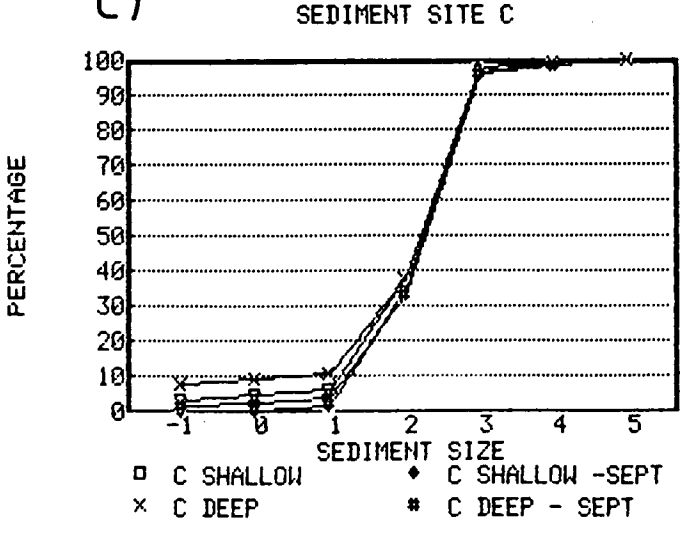
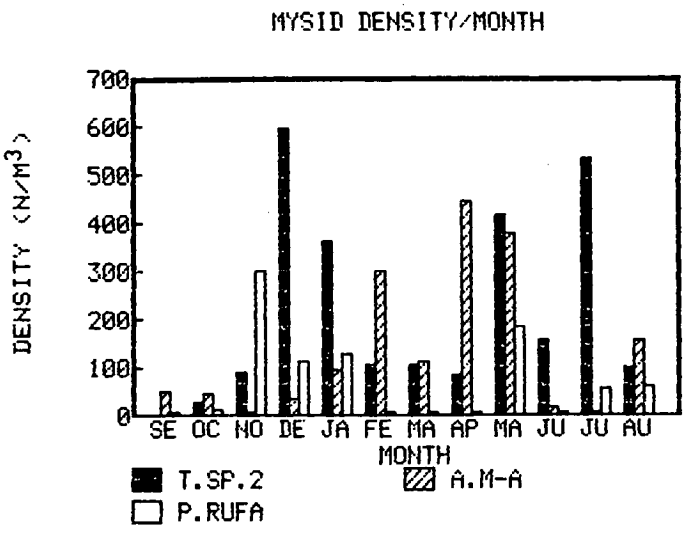

SEDIMENT SITE C
PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
-1
0
1
2
3
4
5
SEDIMENT SIZE
C SHALLOW
C SHALLOW -SEPT
C DEEP
C DEEP - SEPT

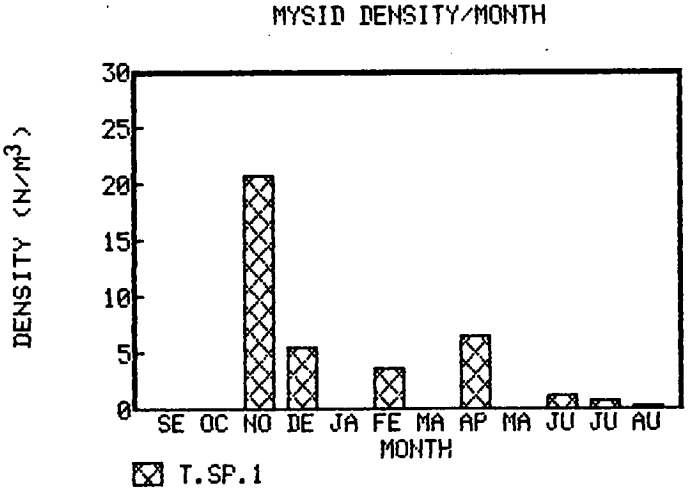
Table 4.2 Analysis of the annual mean composition of sand from One Tree Point. The data is presented in phi-units, where MDϕ = Median; $Q_1\phi$ = 25% Quartile; $Q_3\phi$ = 75% Quartile; QDϕ = Quartile Deviation and $Sk_q\phi$ = Skewness. Calculated according to Morgans (1956).

SITE	MDϕ	$Q_1\phi$	$Q_3\phi$	QDϕ	$SK_q\phi$
A					
SHALLOW	2.4	2.0	2.7	0.35	-0.05
DEEP	2.2	1.4	2.7	0.65	-0.15
B					
SHALLOW	2.4	2.0	2.7	0.35	-0.05
DEEP	2.4	2.0	2.7	0.35	-0.05
C					
SHALLOW	2.2	1.6	2.6	0.5	-0.1
DEEP	2.2	1.6	2.6	0.5	-0.1

Fig. 4.4 Monthly Mysid Densities recorded throughout the year at One Tree Point (includes adults, immature adults and juveniles captured at all three transects).

A) Density of Tenagomysis sp.2, Anisomysis mixta australis, and Paramesopodopsis rufa.
B) Density of Tenagomysis sp.1.
C) Total mysid density recorded at each site.


MYSID DENSITY/MONTH
DENSITY (N/M3)
700
600
500
400
300
200
100
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
T.SP.2
A.M-A
P.RUFA


MYSID DENSITY/MONTH
DENSITY (N/M3)
30
25
20
15
10
5
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
T.SP.1

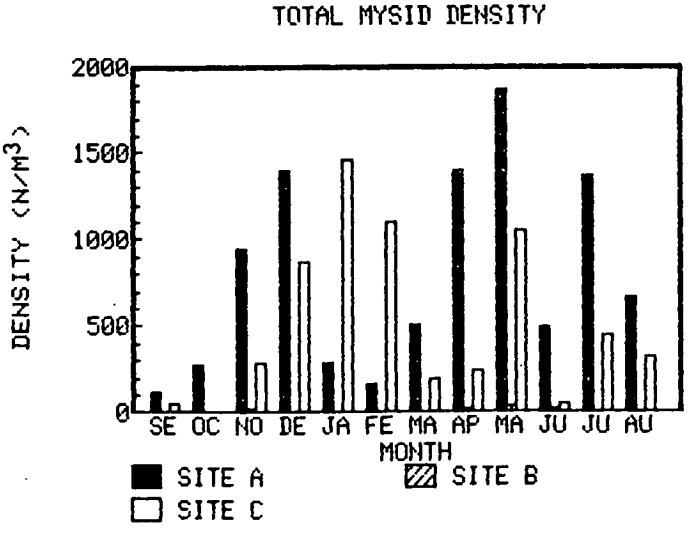

TOTAL MYSID DENSITY
DENSITY (N/M3)
2000
1500
1000
500
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
SITE A
SITE B
SITE C

Table 4.3 Numbers of the rarer mysid species caught at One Tree Point throughout the year. Note that the total number of individuals are given for the 24-hour sampling sessions conducted in October, January and April.

SPECIES AND SITE		MONTH S	O	N	D	J	F	M	A	M	J	J	A	TOTAL
Siriella australis	A		16			22			20					58
	B					3			9		4			16
	C		2						61					63
	TOTAL		18			25			90		4			137
Haplostylus sp.1	A													
	B					1								1
	C													
	TOTAL					1								1
Allomysis sp.1	A													
	B					1								1
	C													
	TOTAL													1
Australomysis acuta	A	8	14	1	14	49			15			30		131
	B		4			2			2					8
	C		17		10	10			80	20				137
	TOTAL	8	35	1	24	61			97	20		30		276
A.incisa	A													
	B								2					2
	C													
	TOTAL													2
Doxomysis sp.1	A					3		35	10					48
	B													
	C		4					6						10
	TOTAL		4			3		41	10					58

Table 4.3 ctd.

SPECIES AND SITE		MONTH S	O	N	D	J	F	M	A	M	J	J	A	TOTAL
Iimysis sp.1	A													
	B								24					24
	C													
	TOTAL													24
#Leptomysis australiensis														
	A								47					47
	B		7						10					17
	C								30					30
	TOTAL		7						87					94
Prionomysis sp.1	A													
	B								4		1			5
	C								10					10
	TOTAL								14		1			15
Tasmanomysis oculata	A													
	B					1								1
	C													
	TOTAL					1								1

Leptomysis (Notomysis n.g. Wittmann, in prep.) australiensis

and in greater numbers than other rare species; Siriella australis and Doxomysis sp.1 were collected in 4 of the 12 months and Leptomysis australiensis and Prionomysis sp.1 were collected on two occasions only. The remaining five species were only collected once during the sampling period; in all cases during a 24 hour sampling session and only at site B.

Nine of the 14 species found at the study site have been described in Chapter 2 as new species and 3 as new genera.

4.3.4 ZONATION

Zonation patterns are evident for the three most common species (Fig. 4.5). They all occurred in greatest numbers at sites A and C, at the edge of the algal covered rock/sand interface. P.rufa, a bright orange-red species, was observed swarming immediately above and between the algae, and in sand patches. A.mixta australis was also found above the algae but mainly at the sand edge and T.sp.2 was more commonly observed at the algal covered rock/sand interface above the sand in areas in which disintegrating algae collect. All occurred at site B (in low numbers), particularly around weed patches and submerged logs etc. Habitat selection within the zone of maximum occurrence was therefore evident.

4.3.5 SEASONAL ABUNDANCE

T.sp.2, A.mixta australis and P.rufa generally exhibit separate peaks of dominance in terms of abundance throughout the year (Fig. 4.4A). The density for all species was low during late winter and early spring, August, September and October. P.rufa was dominant in abundance only in November, and second in abundance during December, January and July. The number of T.sp.2 was greater than that of the other species in December, January, May, June and July, with particularly high densities in December and July. A.mixta australis was dominant during February, March, April, August, September and October; although in March and May the density of T.sp.2 and A.mixta australis were present in similar densities.

There was considerable variation in the numbers of mysids at the different sites. The total mysid density recorded at each site throughout the year is plotted in (Fig. 4.4C). Density was always low at site B, presumably because of the open sand habitat. However, there was a noticeable difference between sites A and C; the density at site A was greater than at C in all months except January and February. This may be due to the underwater topography since the slope of the rocks at site C was steeper and consequently provided a smaller width of habitat than did site A. Site C also was more exposed to southerly weather and hence greater wave action.

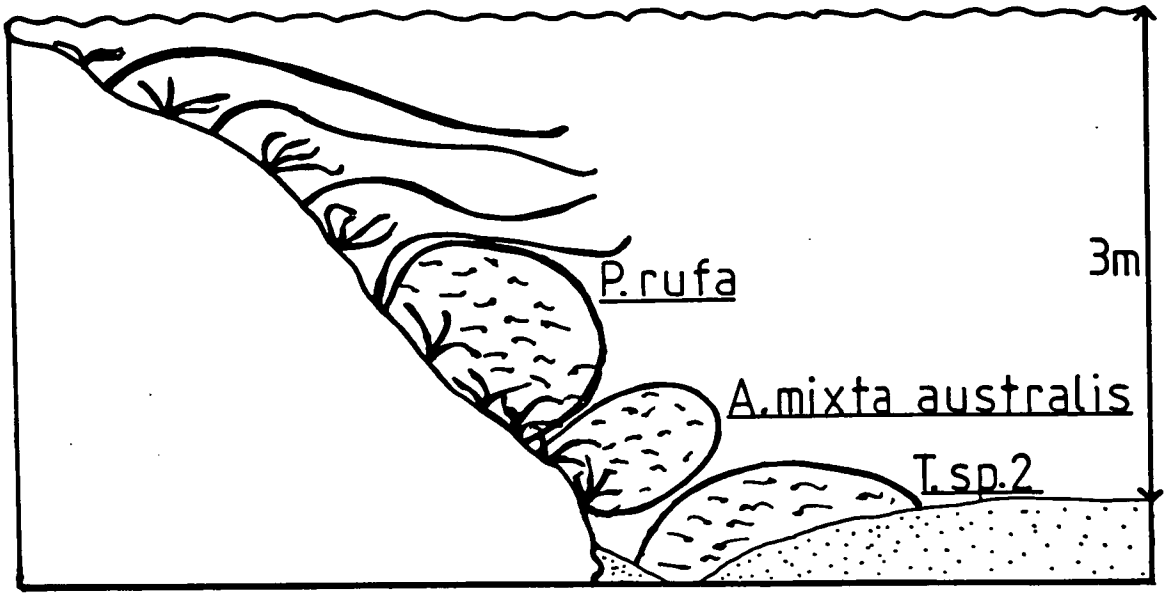


Fig. 4.5 Diagrammatic representation of mysid zonation at One Tree Point.

The density of each species at each site varied throughout the year (Fig. 4.6). For population analysis, sites A and C were combined. This was justified because of the fact that the population structure at both sites was similar at all times. The difference in numbers caught was due in part to the difficulty of sampling a swarming species and partly due to site differences, i.e. habitat available. Exchange of individuals between either side of the bay (sites A and C), is quite possible in terms of distance. The presence of all species in the middle of the bay (site B), also indicated exchange could be possible. This is discussed further in Section 4.3.6.

Ideally, several samples should be collected at each site every month to provide more precise population data. Unfortunately, this was not feasible in the present study, as it would have been necessary to have a team of divers to collect the samples.

4.3.6 POPULATION DYNAMICS

4.3.6.1 Tenagomysis sp.2

Tenagomysis sp.2 was the most common mysid species; a total of 27,760 individuals were collected corresponding to a mean density of 32.4 individuals m^{-3} for sites A and C. The density varied greatly throughout the year (Fig. 4.7). During September, only 1 juvenile was caught; in all other months over 300 and generally over 1000 individuals were collected. Peak abundance occurred in December with other peaks in July, May and January in decreasing order. Although the abundance of T.sp.2 in September and October was low, it seemed that the September value (n=1) was unrealistically low and must be explained in terms of the problems of sampling a swarming species.

The proportions of juvenile, mature males, females with and females without broods throughout the sampling period are plotted in Fig. 4.8A. Except for September, when only one juvenile was caught, all stages were present. Juveniles comprised greater than 30% of the population at all times, except in January and February (only 10-15% juveniles). Brooding females were collected in all months except September, with a greater proportion present from November through to March; therefore breeding is continuous throughout the year. The population peaks of abundance were associated with high numbers of juveniles except in January and February when the population was dominated by gravid females and mature males.

The juveniles plotted in Fig. 4.8A include the immature adults as defined in Section 4.2.6. These are plotted separately in Fig. 4.8B. Generally, at least 1/3 of the juvenile population was composed of immature

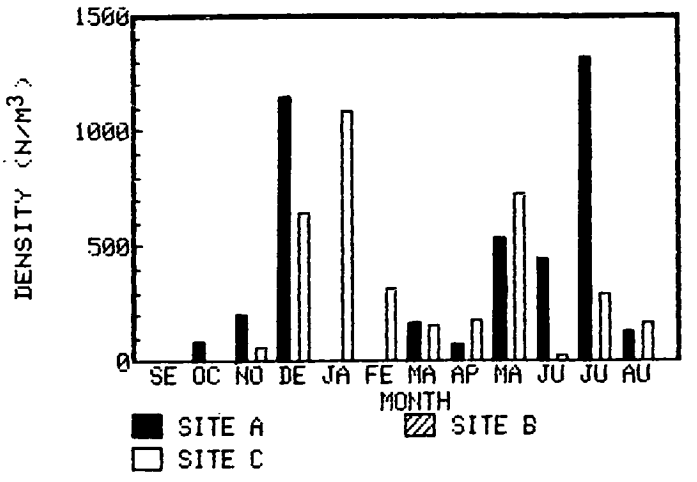
Fig. 4.6 Total density of T.sp.2, A.mixta australis and P.rufa recorded at each site throughout the year.

A) T.sp.2

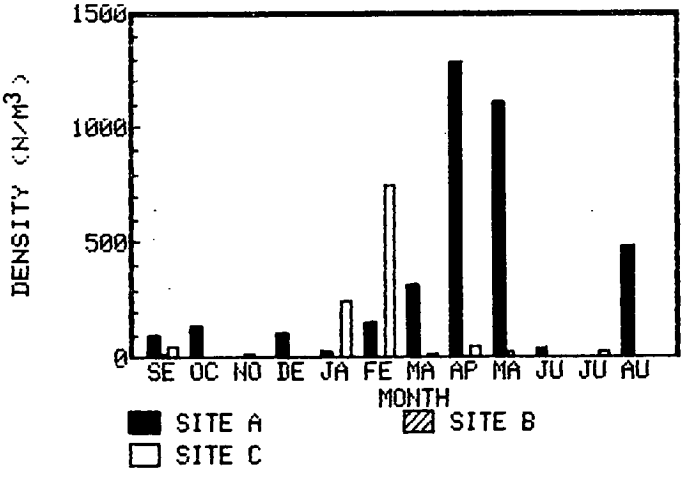
B) A.mixta australis

C) P.rufa

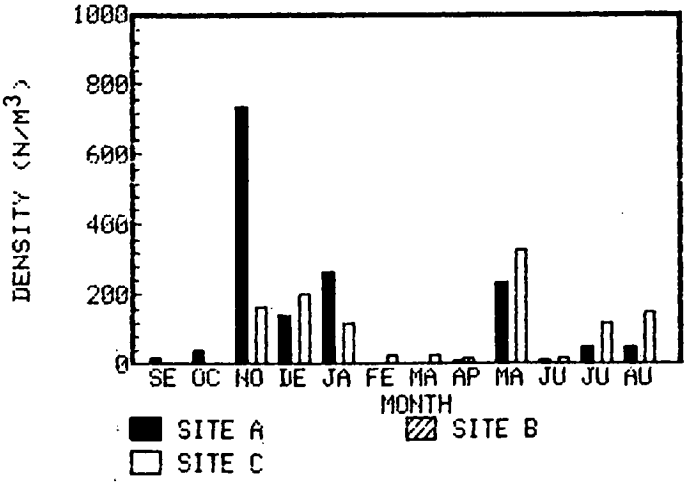
A)


1500
1000
500
0
DENSITY (N/M3)
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
SITE A
SITE B
SITE C

B)


1500
1000
500
0
DENSITY (N/M3)
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
SITE A
SITE B
SITE C

C)


1000
800
600
400
200
0
DENSITY (N/M3)
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
SITE A
SITE B
SITE C

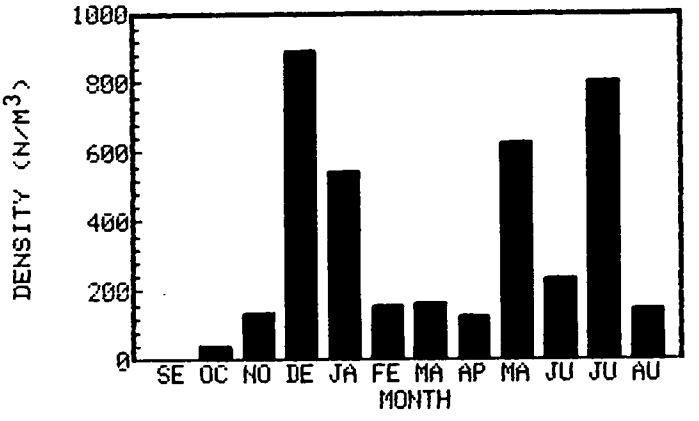
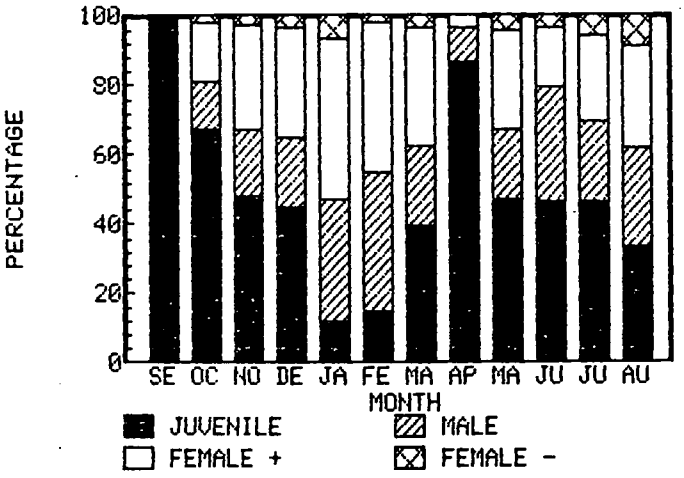


Fig. 4.7 Density of Tenagomysis sp.2 at sites A and C combined throughout the year.

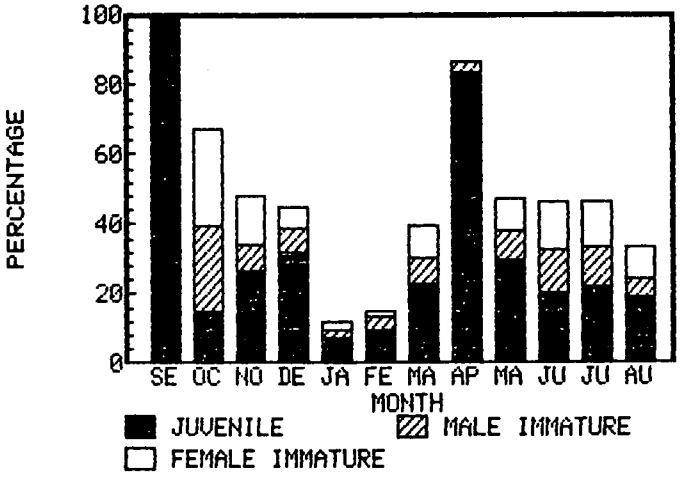
Fig. 4.8 Population composition of Tenagomysis sp.2 throughout the year.

A) Percentage of population composed of juveniles, males, brooding females (female +) and non-brooding females (female -) in each month.
B) Proportion of juveniles and immature adults in the population in each month.
C) Sex ratio of the population throughout the year.

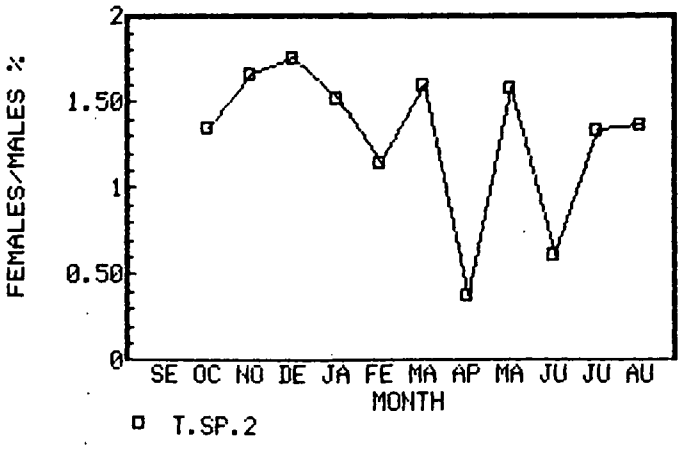
A)


PERCENTAGE
100
80
60
40
20
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
JUVENILE
MALE
FEMALE +
FEMALE -

B)


PERCENTAGE
100
80
60
40
20
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
JUVENILE
MALE IMMATURE
FEMALE IMMATURE

C)


FEMALES/MALES %
2
1.50
1
0.50
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
T.SP.2

adults. However, during October the majority of the juvenile population were immature adults. Many of these immature adults mature during November and breed. The juveniles produced by the spring breeding are responsible for the major population peak in December. These juveniles mature rapidly (indicated by the lower percentages of juveniles present in January and February), and join the breeding population. The large percentage of juveniles present in April probably result from a late summer breeding. Since breeding is continuous, it is difficult to determine how many generations are produced in a year.

The sex ratio of T.sp.2 throughout the year (Fig. 4.8C) shows that generally more females were present than males (i.e. ratio > 1). However, on two occasions, April and June, males outnumbered females. The sex ratio for the entire year was 1.42.

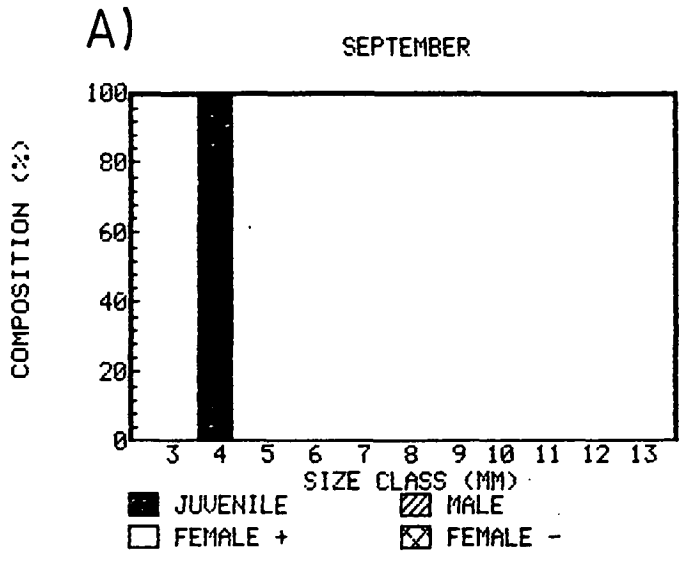
Monthly results showing the size class distribution of the T.sp.2 population are plotted in Fig. 4.9A-L. The largest size class collected was 10.0-10.9mm, found in November, December and January. In the other months, the maximum size class was 9.0-9.9mm; with 8.0-8.9 in April. The smallest size of the males at maturity ranged between the 6.0-6.9 and 7.0-7.9mm size classes. During November-March the smallest mature males were in the 6.0-6.9mm size class; in all other months they were 7.0-7.9mm in length. Seasonal variation of the mean monthly length of males throughout the year calculated from size-class data is plotted in Fig. 4.10. Smaller males were found in autumn than at other times of the year. Analysis of the female population and breeding cycles can be found in Chapter 5.

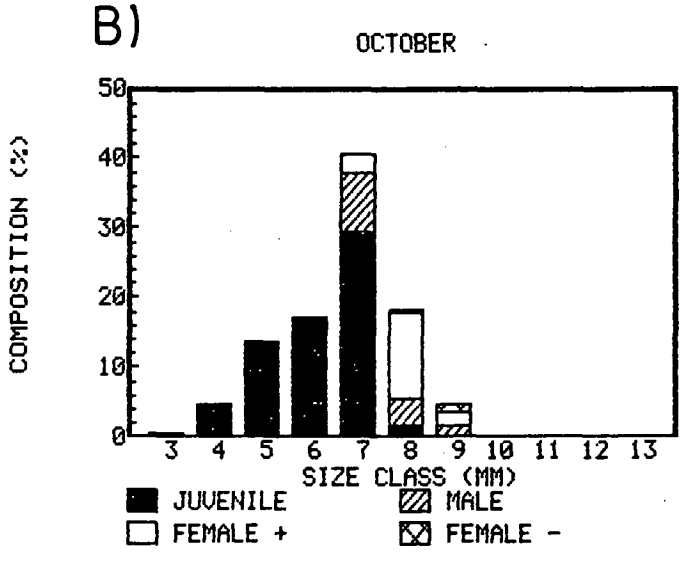
4.3.6.2 *Anisomysis mixta australis*

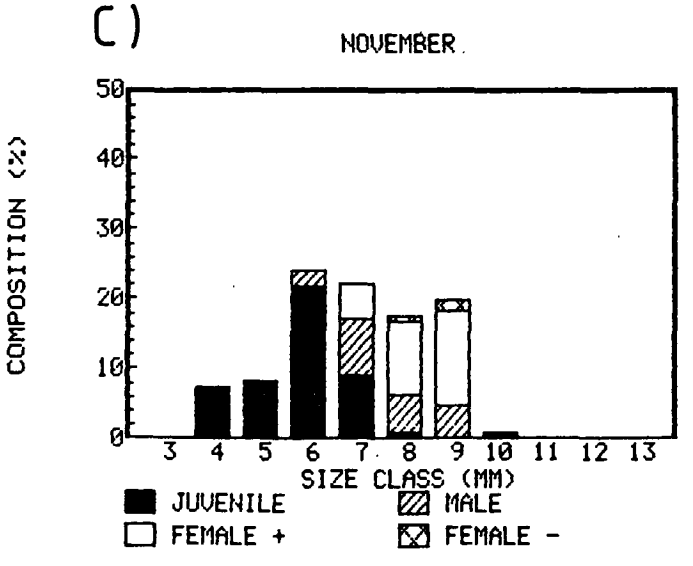
A.mixta australis was the second most abundant mysid species collected at One Tree Point. A total of 17,557 individuals were captured; the mean density for sites A and C was 20.5 individuals m^{-3}. Variation in the density in each month is represented in Fig. 4.11. The lowest number of individuals caught was n=23 in November. In all other months more than 100 and usually over 500 individuals were collected. Density was greatest during April, May and February.

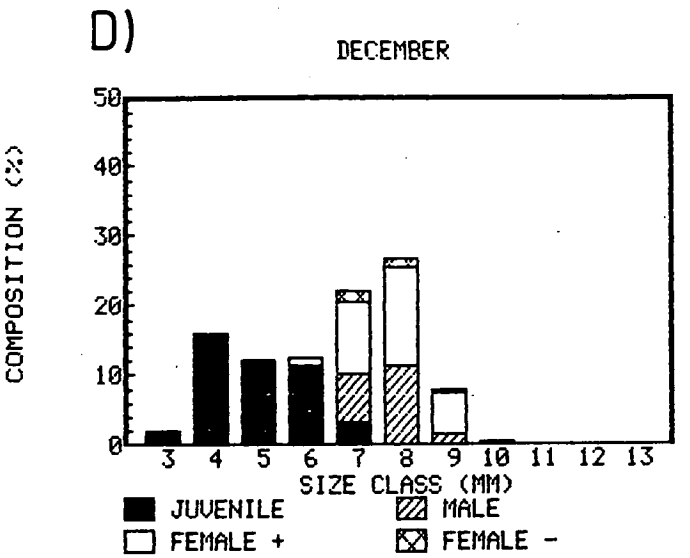
The percentage of juveniles, males and females in each month are plotted in Fig. 4.12A. Mature adults dominated the population from September to February and also in April. In March and from May to August over 85% of the population was composed of juveniles. Gravid females were present from September till May; none was found in the winter months, June, July and August. During these months no males were collected but a small percentage of mature females with empty brood pouches were present. The

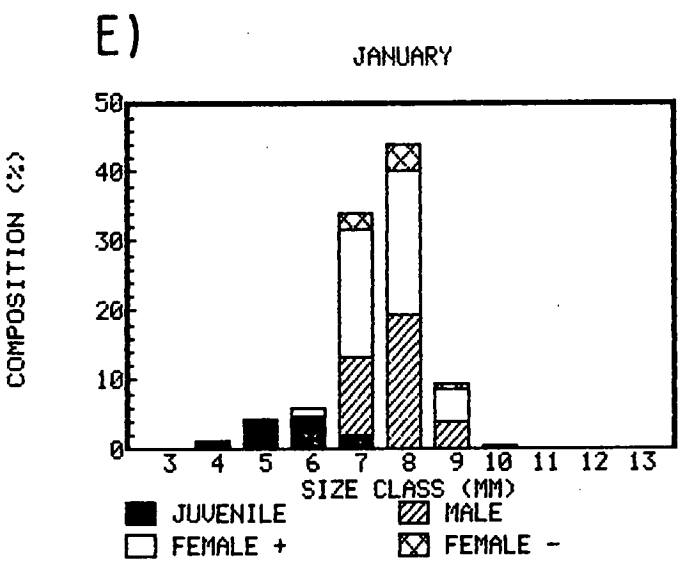
Fig. 4.9 A-L Length-frequency histograms for Tenagomysis sp.2 collected in each month from September 1982 to August 1983.

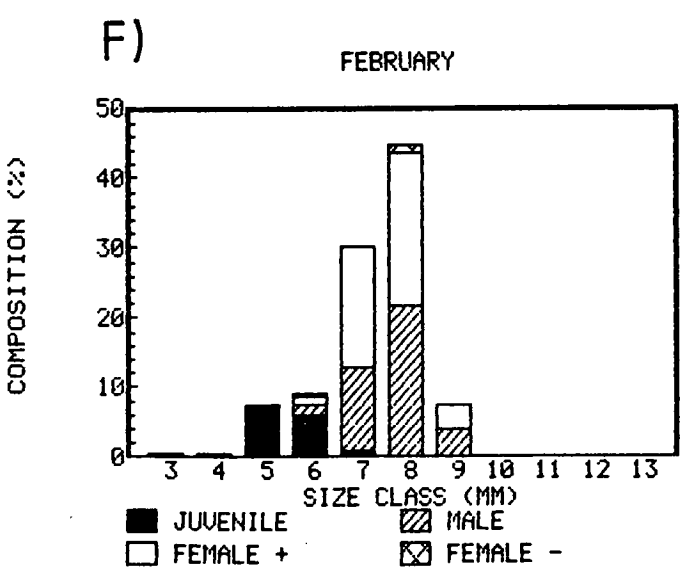

A)
SEPTEMBER
COMPOSITION (%)
100
80
60
40
20
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

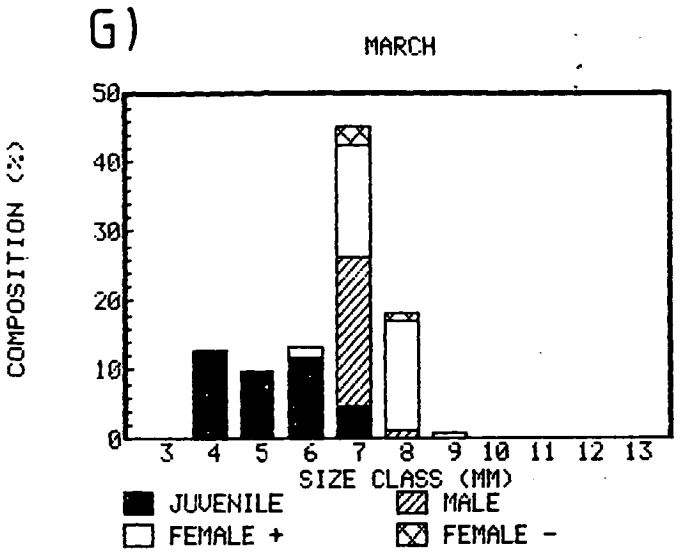

B)
OCTOBER
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

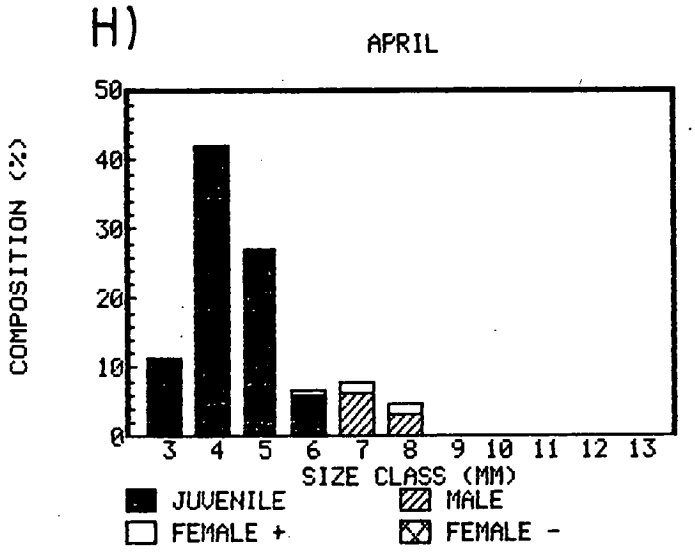

C)
NOVEMBER
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

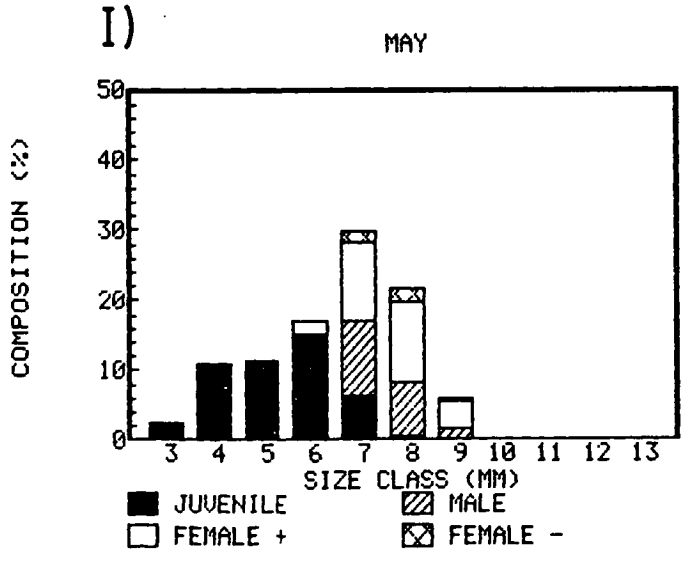

D)
DECEMBER
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -


E)
JANUARY
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

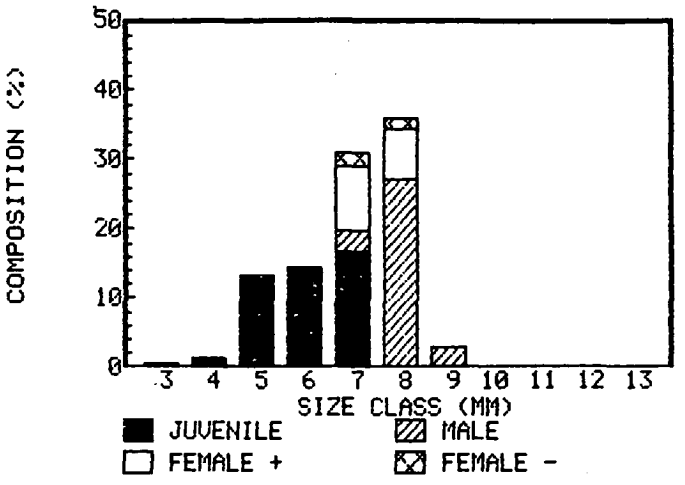

F)
FEBRUARY
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -


G)
MARCH
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

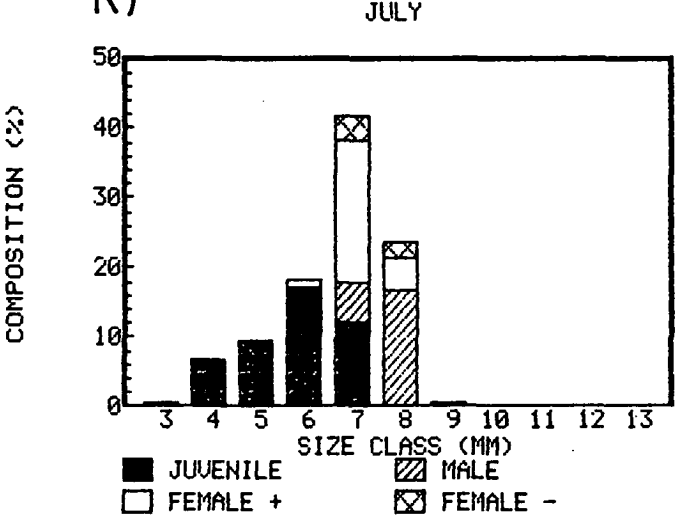

H)
APRIL
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -


I)
MAY
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

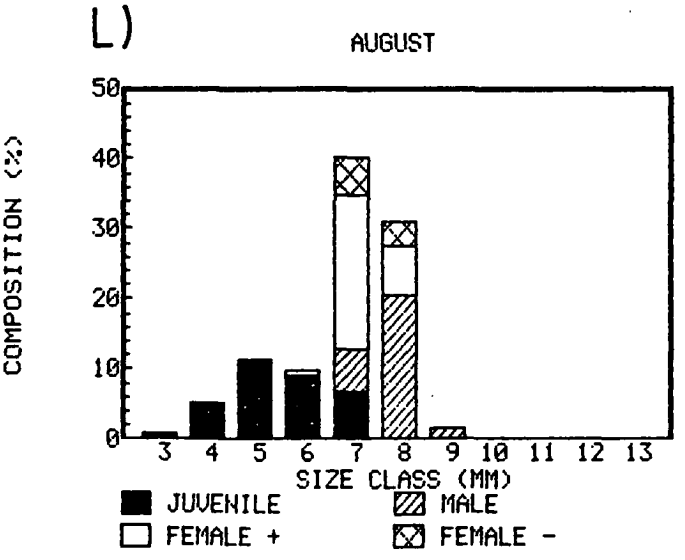
J)


JUNE
COMPOSITION (%)
0
10
20
30
40
50
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
FEMALE +
MALE
FEMALE -

K)


JULY
COMPOSITION (%)
0
10
20
30
40
50
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
FEMALE +
MALE
FEMALE -

L)


AUGUST
COMPOSITION (%)
0
10
20
30
40
50
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
FEMALE +
MALE
FEMALE -

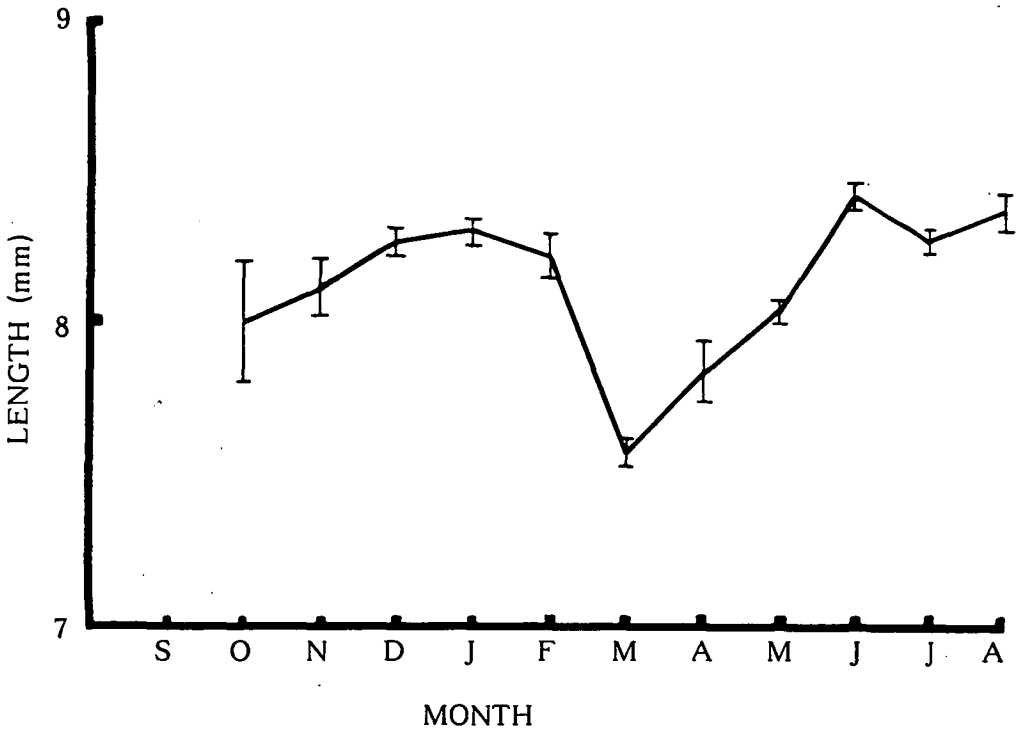


Fig. 4.10 Mean monthly male length ± 95% confidence intervals for Tenagomysis sp.2.

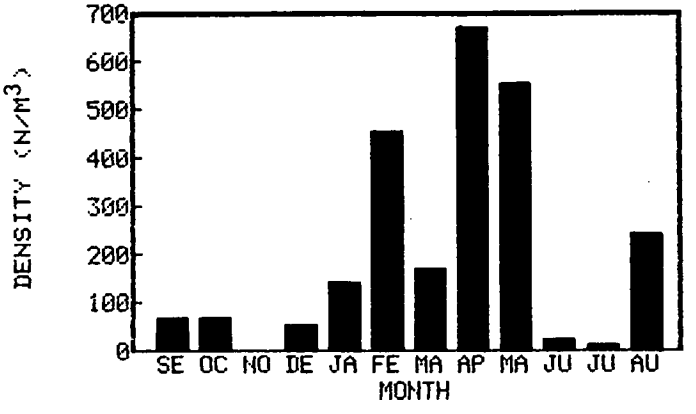


Fig. 4.11 Density of Anisomysis mixta australis at sites A and C combined throughout the year.

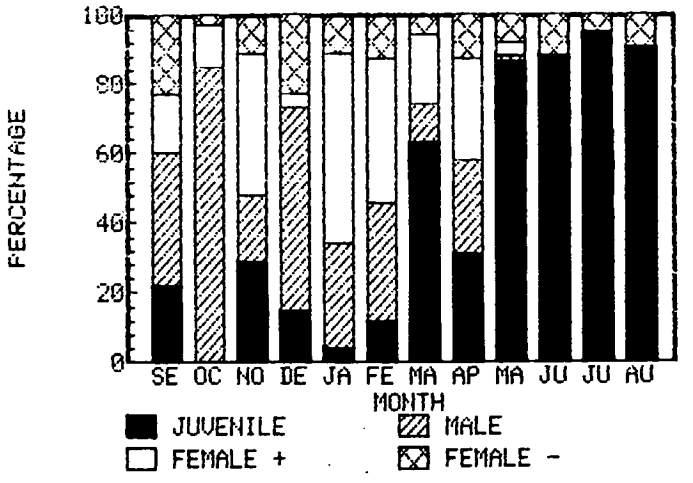
Fig. 4.12 Population composition of Anisomysis mixta australis throughout the year.

A) Percentage of population composed of juveniles, males, brooding females (female +) and non-brooding females (female -) in each month.

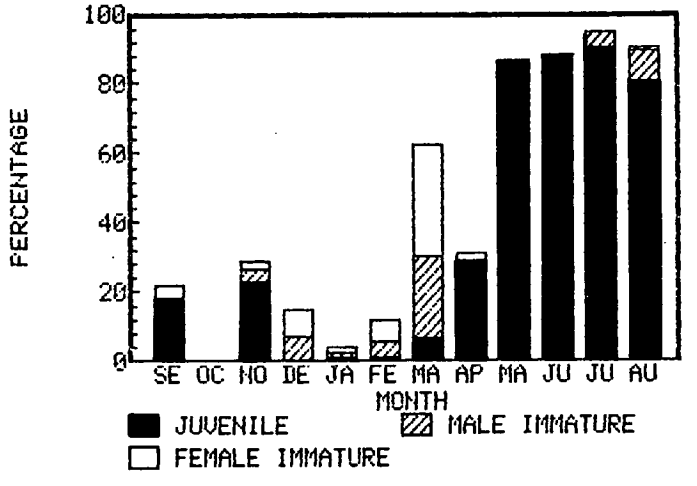
B) Proportion of juveniles and immature adults in the population in each month.

C) Sex ratio of the population throughout the year.

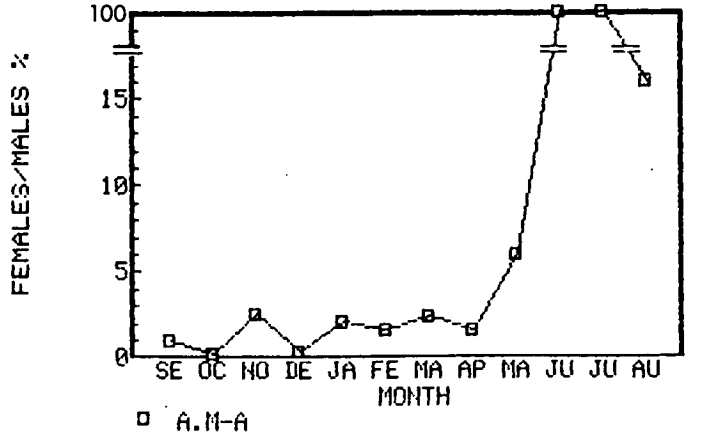
A)


PERCENTAGE
100
80
60
40
20
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
JUVENILE
MALE
FEMALE +
FEMALE -

B)


PERCENTAGE
100
80
60
40
20
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
JUVENILE
MALE IMMATURE
FEMALE IMMATURE

C)


FEMALES/MALES %
100
15
10
5
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
A.M-A

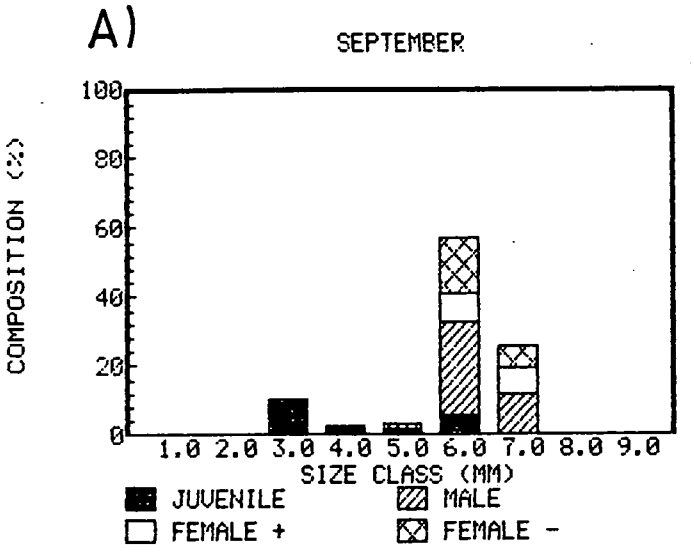
total absence of mature males at this time suggests that they do not survive the winter.

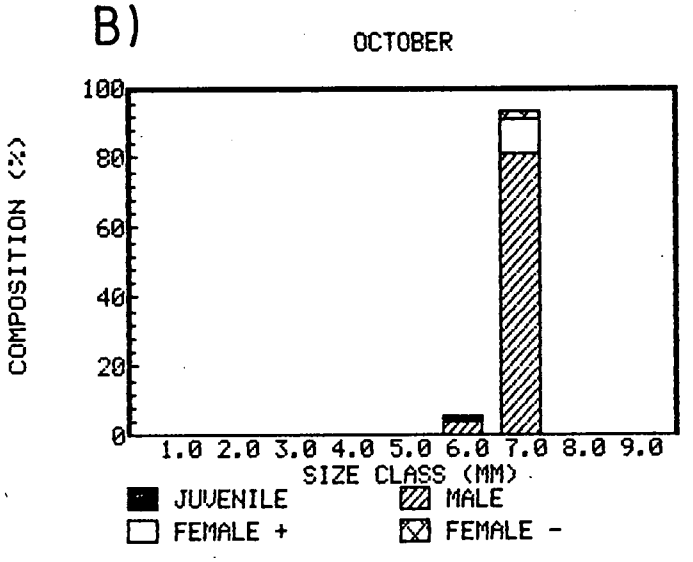
The population peaks of abundance in April and May are dominated by juveniles, but in February the population is composed mainly of gravid females and mature males. Examination of the juvenile population in each month (Fig. 4.12B), shows that from December to March the majority of the juveniles are recognizable as either immature males or females. Since from April to June immature adults are present in the population in extremely low numbers (n=0 in July), the immature adults observed as late as March must have matured by the time of the May sampling. During July and August, immature males began appearing in the juvenile population. By September (in the previous year) the majority of the population was composed of mature adults and breeding was underway. The low number of juveniles present in October (0.4% of the population) indicates that all the over-wintering juveniles have matured. Consequently, the juveniles collected in November can be regarded as the progeny of the spring generation. These appear to mature rapidly (as evidenced by the fact that all juveniles in the December sample are recognizable as either immature females or males), and by January they are mature and breeding, producing the summer generation. At least one and probably two summer generations are produced; many of the juveniles maturing during March were breeding by April forming an autumn generation. Most of the adult population died (or disappeared) at the end of autumn leaving an over-wintering population dominated by juveniles produced during later summer and autumn.

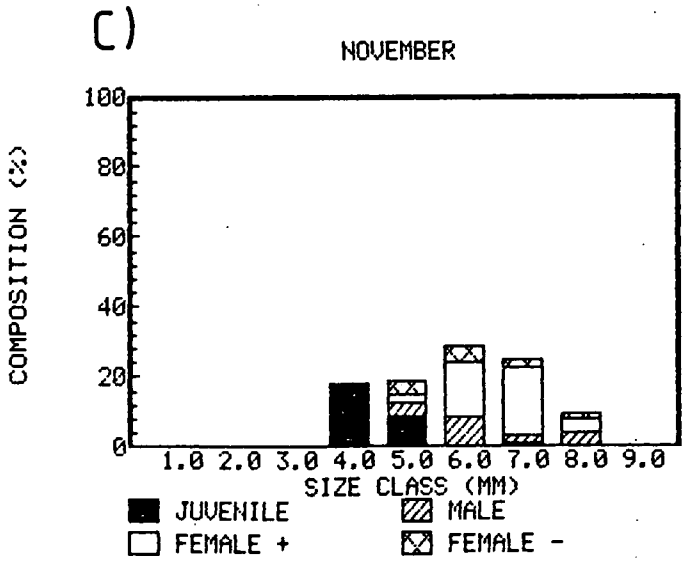
The sex ratio (females/males) varied throughout the year, with the value for the entire year being 1.56 (Fig. 4.12C). Males dominated the adult population in October and December, and females dominated in September, November and January till April with a ratio of between 1.02-2.65. Since males disappeared from the population over winter, the ratio rapidly increased in May with virtually 6 times as many females as males. In June and July all of the adults were females and in August females outnumbered males by 16:1.

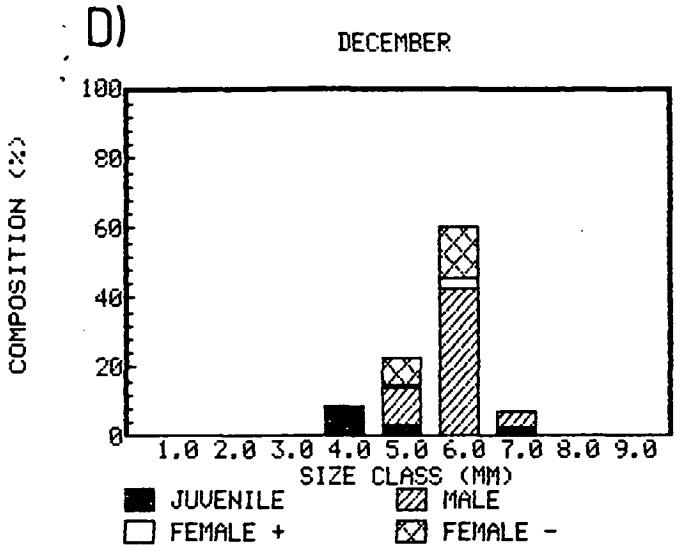
Monthly results showing the size-class distribution of the A.mixta australis population are plotted in Figs. 4.13A-L. Individuals in the maximum size class, 8.0-8.9mm were found in November and January, and also a low number were present in October (n=2; 0.4%) and in February (n=5; 0.1%). The maximum size class found in September, December, April and May (n=1; 0.02%) was 6.0-6.9mm, and during June and July the largest individuals were only 5.0-5.9mm in length. Juveniles were present in the 6.0-6.9mm size class during early spring (September and October), but from November to

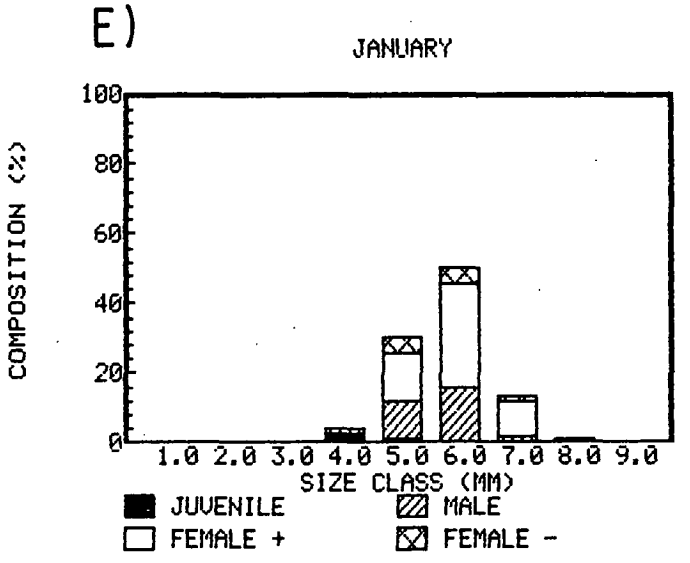
Fig. 4.13 A-L Length-frequency histograms for Anisomysis mixta australis collected in each month from September 1982 to August 1983.

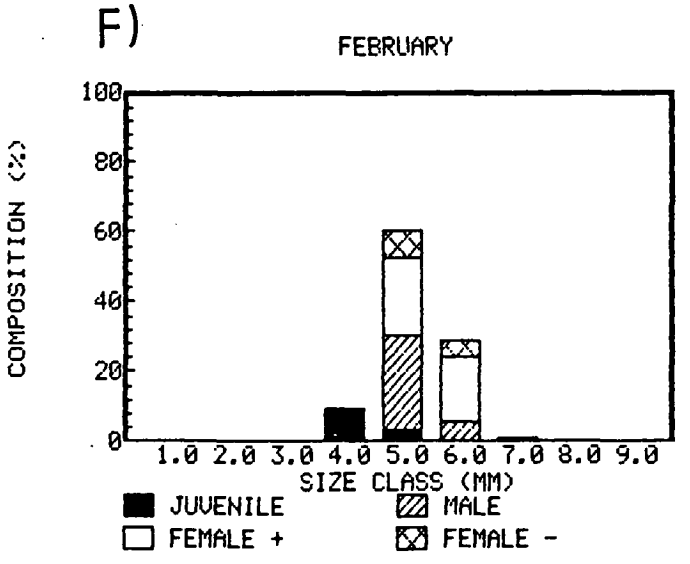

A)
SEPTEMBER
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -


B)
OCTOBER
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

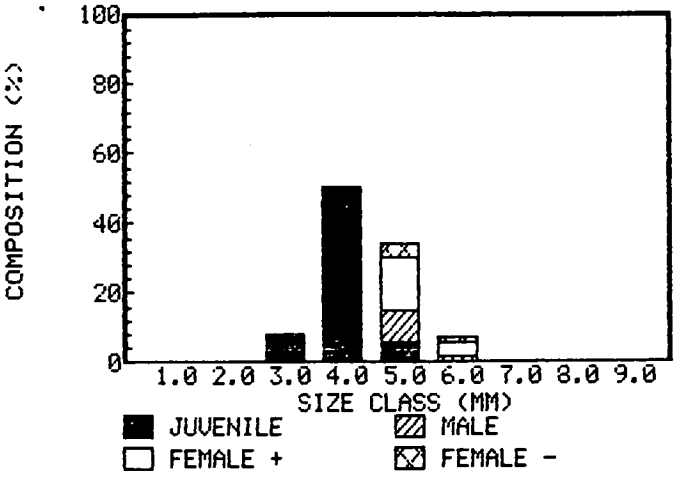

C)
NOVEMBER
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -


D)
DECEMBER
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

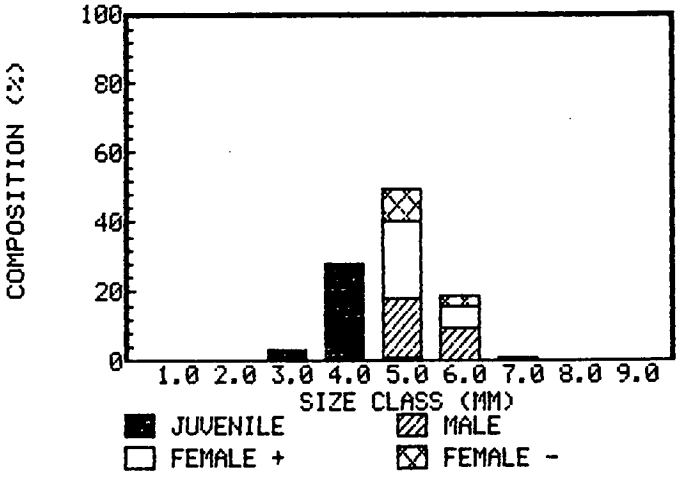

E)
JANUARY
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -


F)
FEBRUARY
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

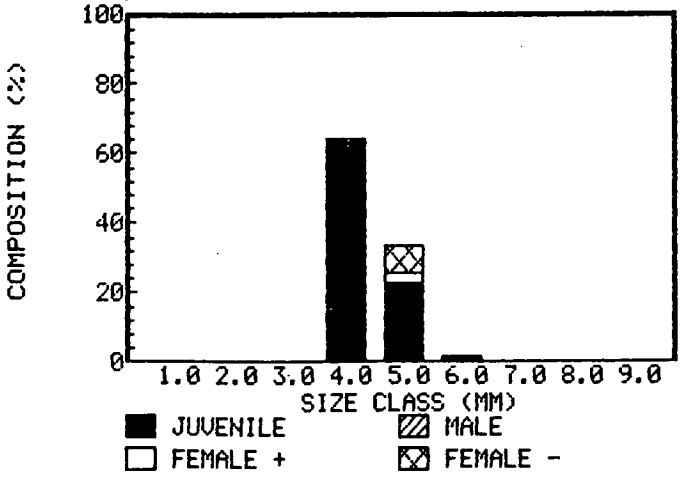
G)


MARCH
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

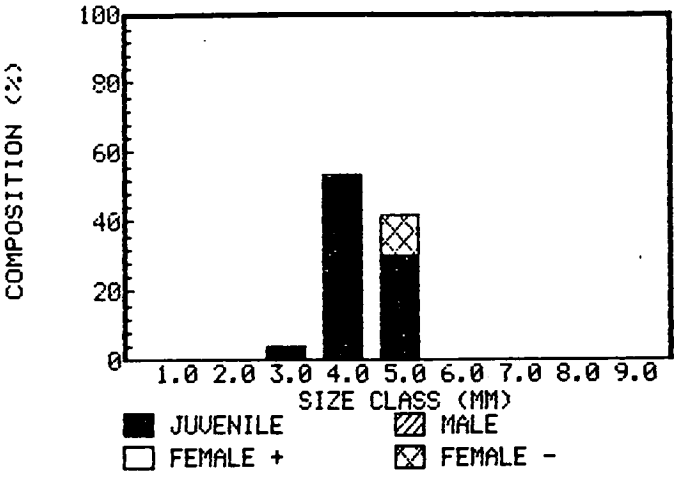
H)


APRIL
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

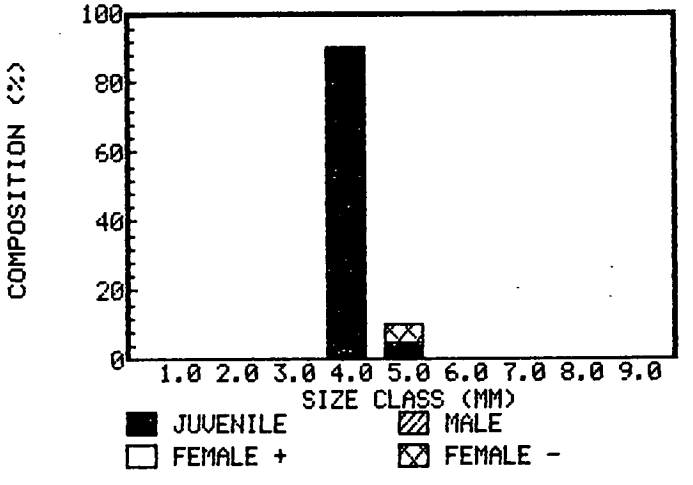
I)


MAY
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

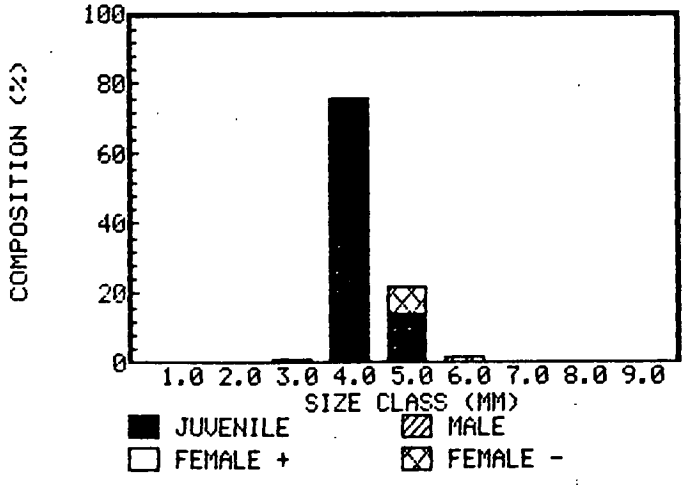
J)


JUNE
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

K)


JULY
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

L)


AUGUST
COMPOSITION (%)
100
80
60
40
20
0
1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

April the majority of individuals were mature in this size class. A low percentage of individuals in the 4.0-4.9mm size class were also mature in January (1.5%; n=15) and less than 1% of the total population was mature in this size class during February, March and April. During winter, all of the 4.0-4.9mm and most of the 5.0-5.9mm size classes were composed only of juveniles. The seasonal decrease in size at which maturity is reached is thus distinct.

The average male length in each month is displayed in Fig. 4.14. A general trend of larger males in spring and progressively smaller males over summer and autumn is evident. These averages are calculated from size class data using the mid-point of each size class as the length of all individuals within that size class. Consequently, only a basic pattern of changes can be obtained. The females and breeding patterns are discussed in further detail in Chapter 5.

4.3.6.3 Paramesopodopsis rufa

Paramesopodopsis rufa was the third most common mysid species collected at the study site, constituting just over half as many individuals (n=9691) as A.mixta australis and only about one third of the number of T.sp.2 present. The annual mean density for P.rufa was $11.3m^{-3}$. Monthly variation of the density for P.rufa is plotted in Fig. 4.15. Density was low in September, October, February, March, April and June ($n<200$); in all other months more than 500 individuals were present in each sample. The major population peak of abundance occurred in November, and peaks were also present in May, January and December in decreasing order.

The percentages of juveniles, males, and females with and without broods in each month are plotted in Fig. 4.16A. Juveniles were present throughout the year, comprising more than 50% of the population in October, November, January, April to August, and over 80% in October, November, April, May and June. The lowest percentage of juveniles found was in September. The dramatic increase observed in October and November presumably corresponds to the production of a spring generation. Gravid females were present in all months except June, but in very low numbers from May to August. Reproduction occurred during winter but at a reduced rate. The population peaks of abundance in November and May were dominated by juveniles, but in December and January a large proportion of gravid females and mature males were present.

Examination of Fig. 4.16B, reveals that the proportion of immature adults in the juvenile population increased progressively from May through to August (September in the previous year follows this trend). This

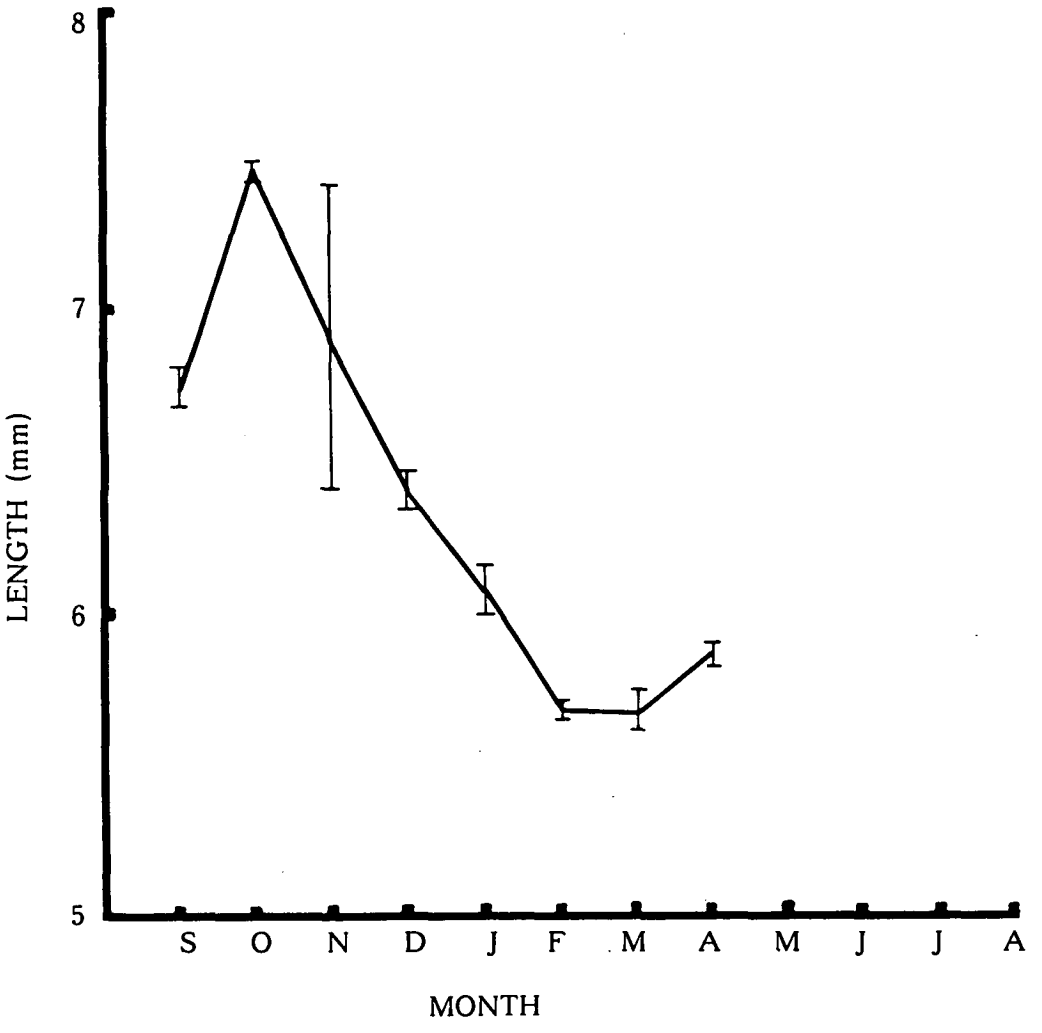


Fig. 4.14 Mean monthly male length ± 95% confidence intervals for Anisomysis mixta australis.

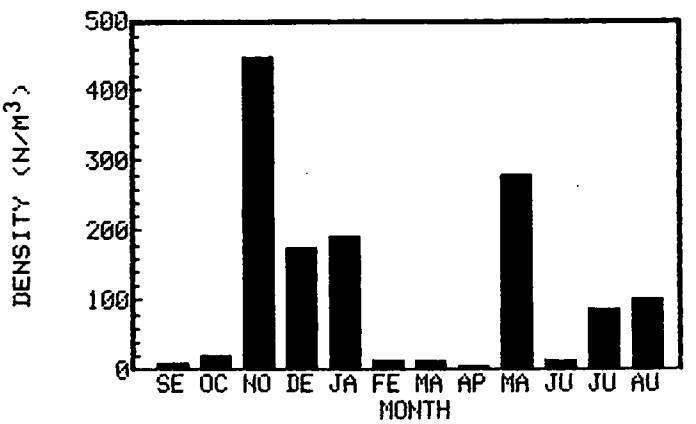


Fig. 4.15 Density of Paramesopodopsis rufa at sites A and C combined throughout the year.

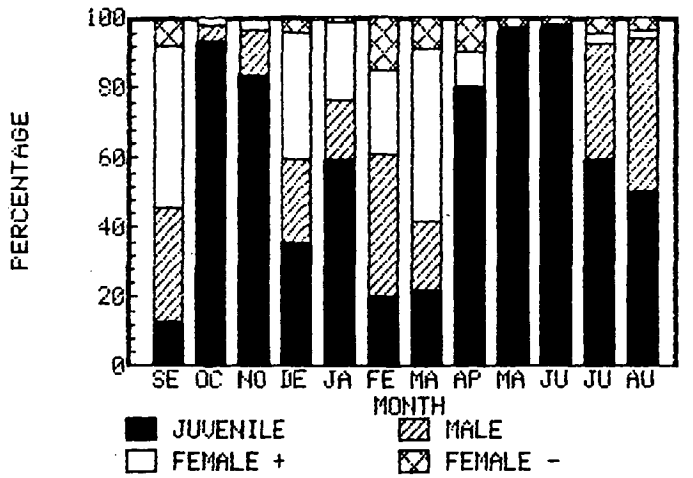
Fig. 4.16 Population composition of Paramesopodopsis rufa throughout the year.

A) Percentage of population composed of juveniles, males, brooding females (female +) and non-brooding females (female -) in each month.

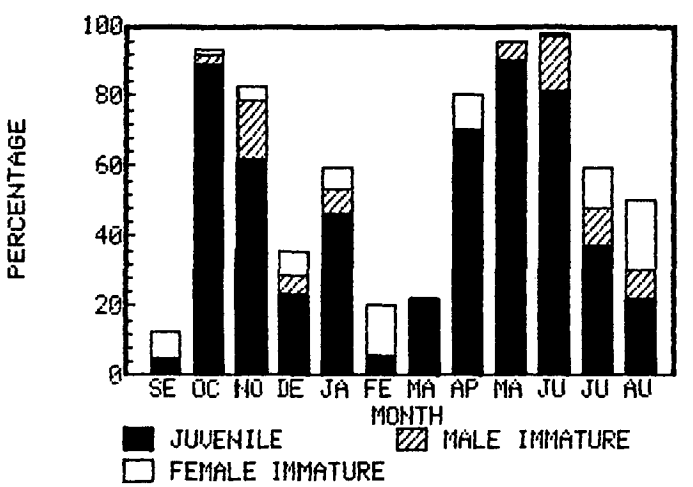
B) Proportion of juveniles and immature adults in the population in each month.

C) Sex ratio of the population throughout the year.

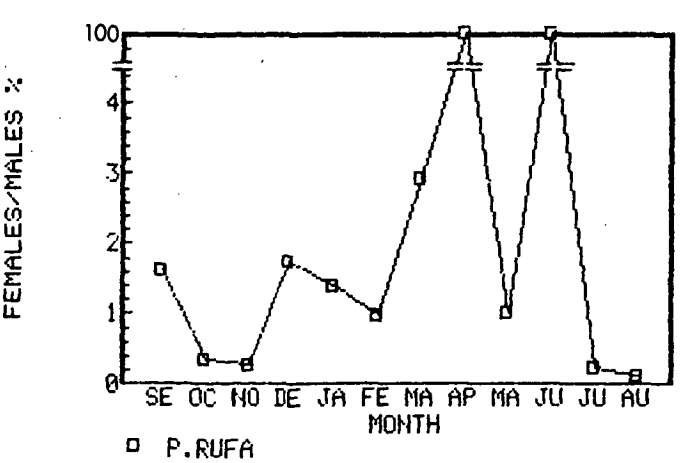
A)


PERCENTAGE
100
80
60
40
20
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
JUVENILE
MALE
FEMALE +
FEMALE -

B)


PERCENTAGE
100
80
60
40
20
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
JUVENILE
MALE IMMATURE
FEMALE IMMATURE

C)


FEMALES/MALES %
100
4
3
2
1
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
P.RUFA

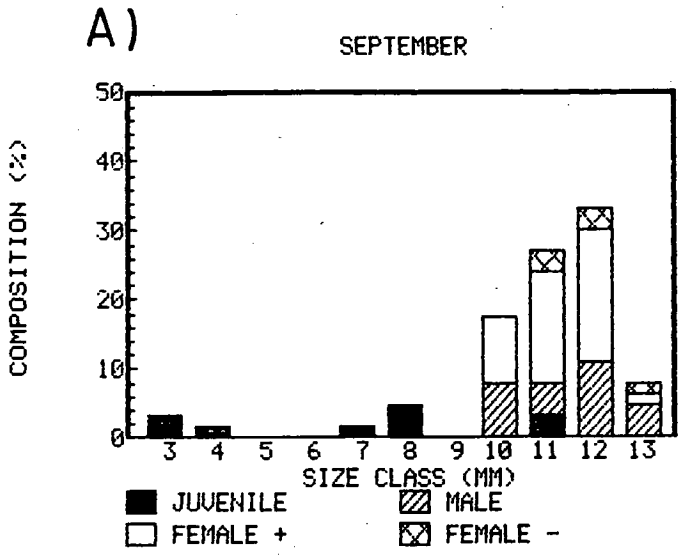
indicates that the juveniles which over-winter were virtually all mature by spring. They reproduce by September forming the spring generation, observed as peaks of abundance in November and December dominated by juveniles. These juveniles grow, mature and reproduce in early summer, December and January, indicated by the lower percentage of juveniles in the population in December and the large percentage of brooding females present at this time. Breeding was intense over summer till April. At least one if not two summer generations were produced and the juveniles of at least the first were nearly mature in February and were breeding in March forming an autumn generation. The breeding rate slowed down from autumn (April) and during winter so that the over-wintering population was composed of juveniles produced by the late summer and autumn generations. It is interesting to note that immature males were seen maturing in the over-wintering population (Fig. 4.16B) before females. However, this may have been partly due to the ease of identifying immature males by the presence of developing pleopods, compared to finding developing brood lamellae in immature females.

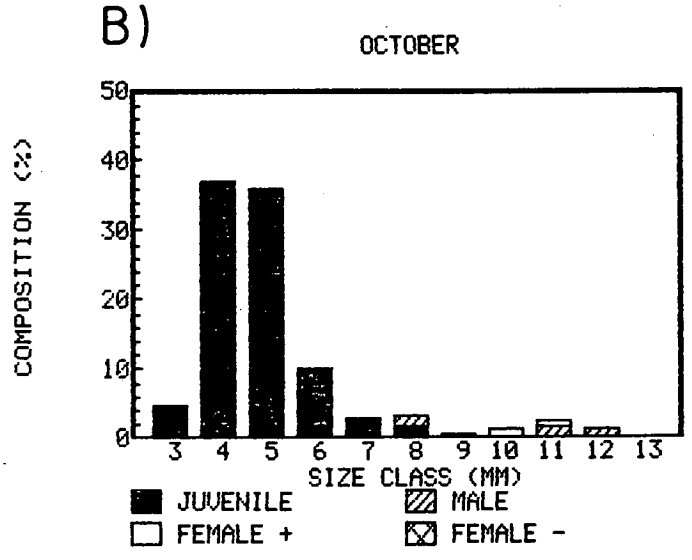
The sex ratio of P.rufa varied throughout the year (Fig. 4.16C). More males than females were present during October, November, February, July and August. In all other months females outnumbered males by about 1.5 times, but in March nearly 3 times as many females than males were present. No males were found in April and June, and only a very low percentage in May (n=10; 0.5%). The reduced number of males at this time, also indicates a break in the breeding cycle. It seems, therefore, that only a few adults over-winter. The sex ratio for the entire year was 0.80, indicating that males outnumbered females.

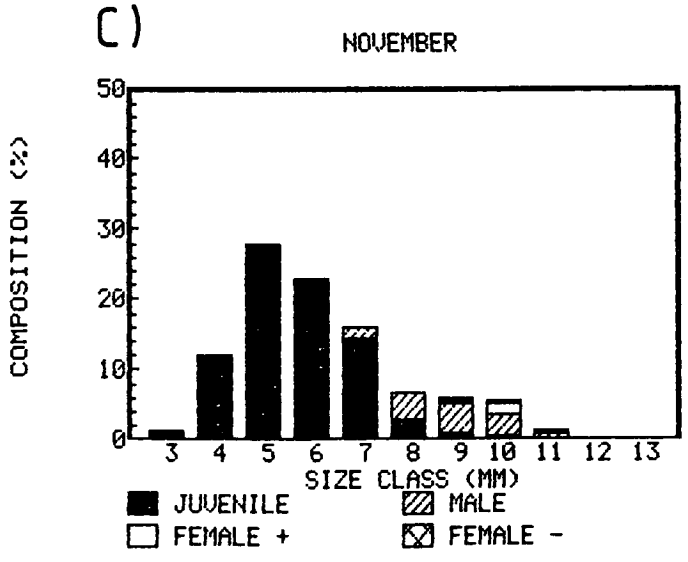
Examination of the size class distribution of the population throughout the year (Figs. 4.17A-L) shows clearly the release of young juveniles in October and November from the September adults. Subsequent maturation of the spring generation and production of the summer and autumn generations are also easily distinguished.

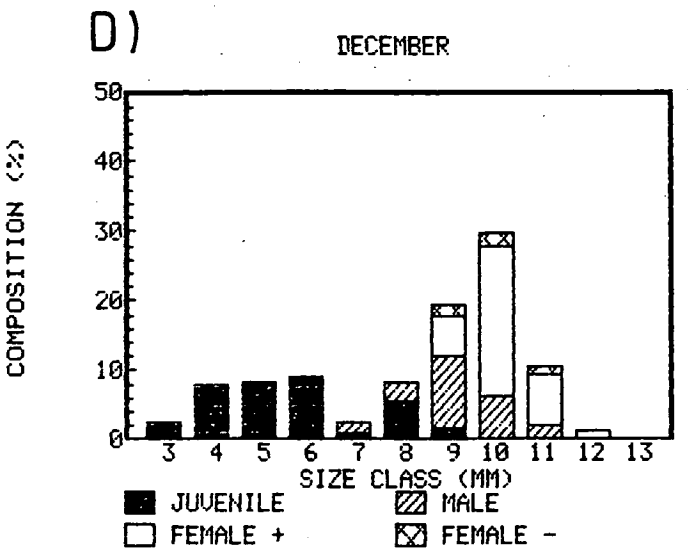
Individuals in the largest size class, 13.0-13.9mm, were collected in September, November (n=6; 0.23%) and January. No individuals in the 12.0-12.9mm size class were found after January, and the 11.0-11.9mm size class was not represented during April, May and June. The largest size classes (>12.0mm) presumably represent over-wintering individuals which die off during spring and summer.

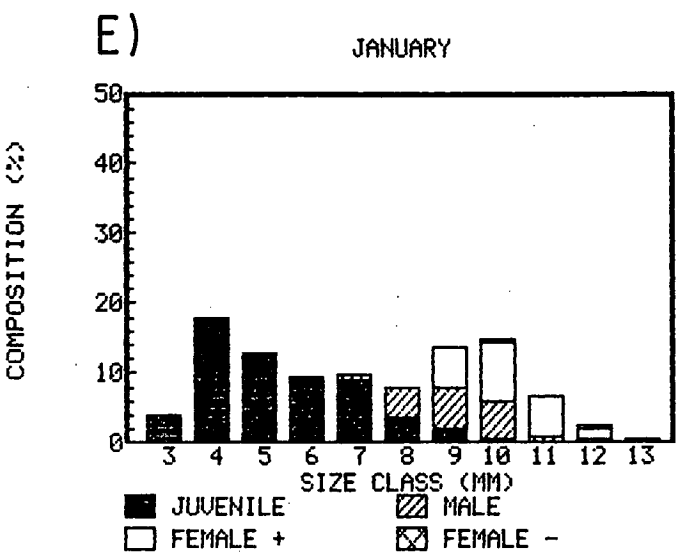
The size at first maturity of males and females in the population varied throughout the year. From May till August few adults in the 9.0-9.9mm size class were caught, whereas in October, February and March

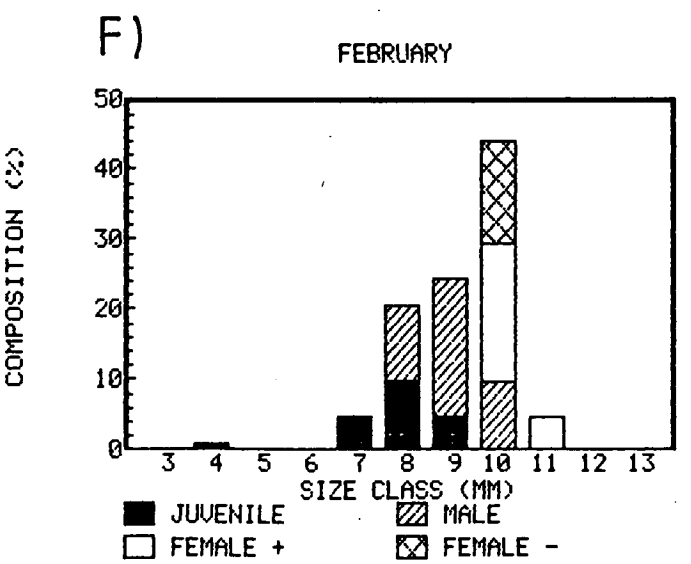

A)
SEPTEMBER
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -


B)
OCTOBER
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

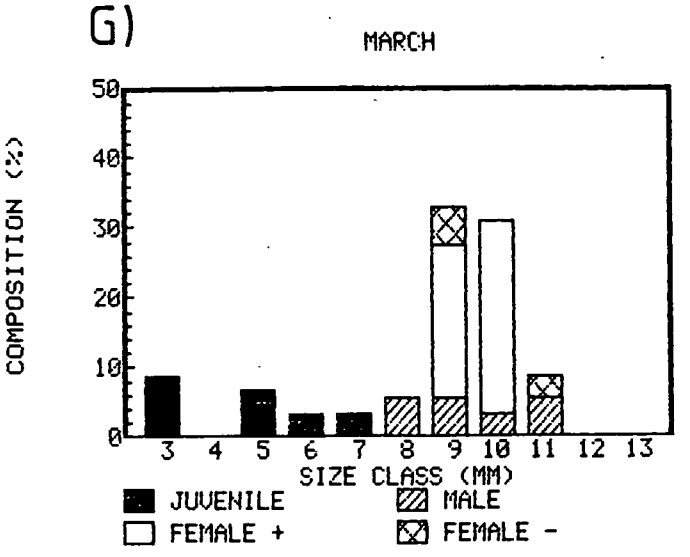

C)
NOVEMBER
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -


D)
DECEMBER
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

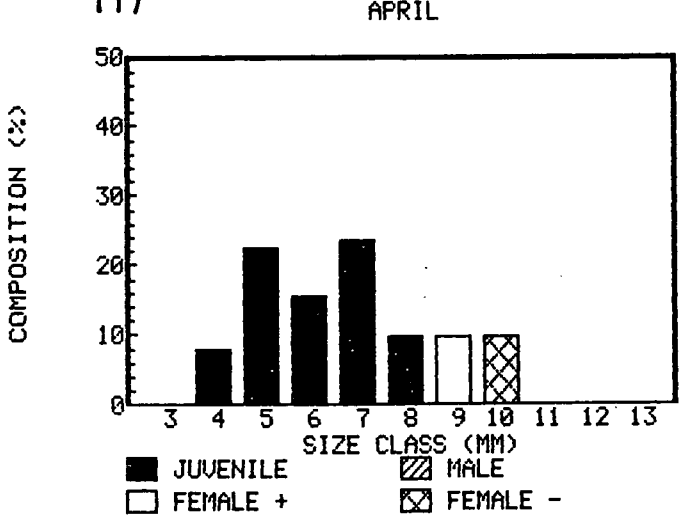

E)
JANUARY
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -


F)
FEBRUARY
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

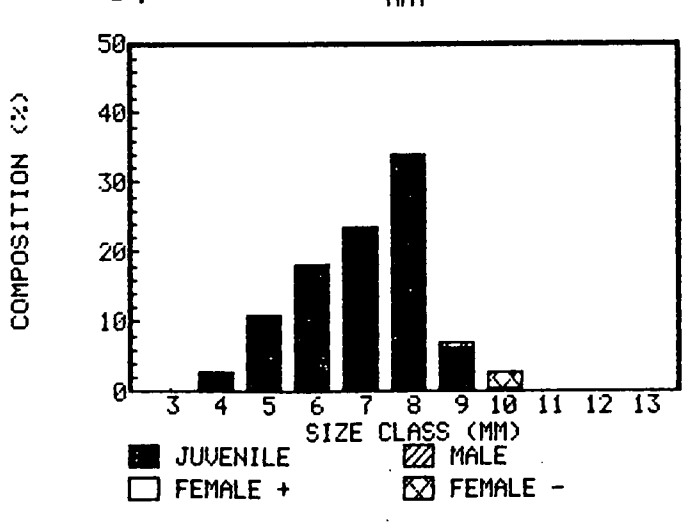
G)


MARCH
COMPOSITION (%)
0
10
20
30
40
50
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

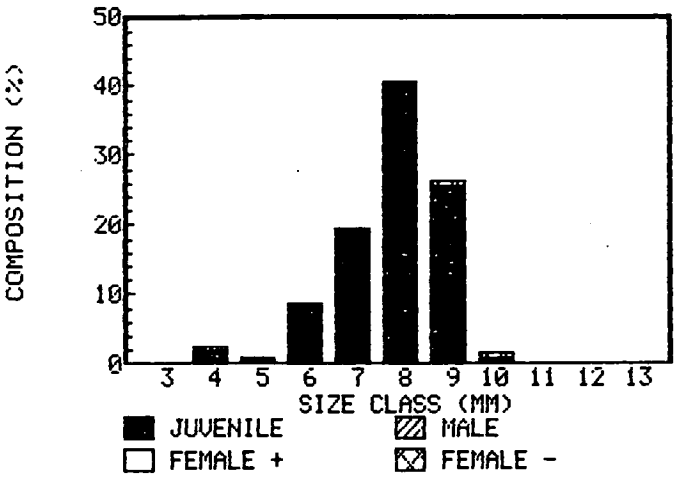
H)


APRIL
COMPOSITION (%)
0
10
20
30
40
50
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

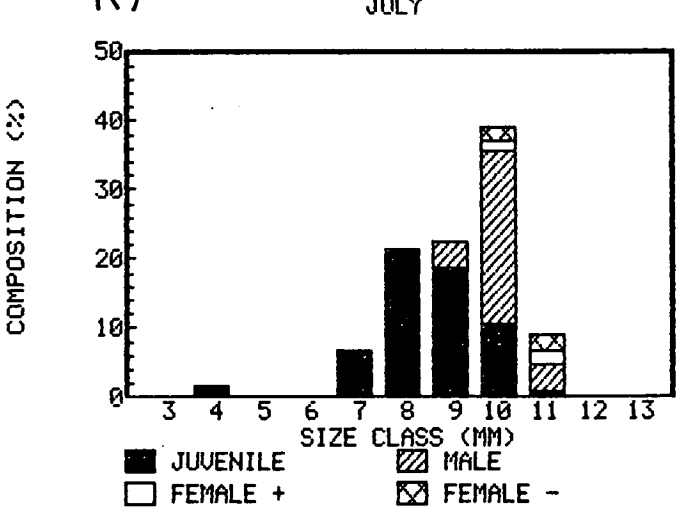
I)


MAY
COMPOSITION (%)
0
10
20
30
40
50
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

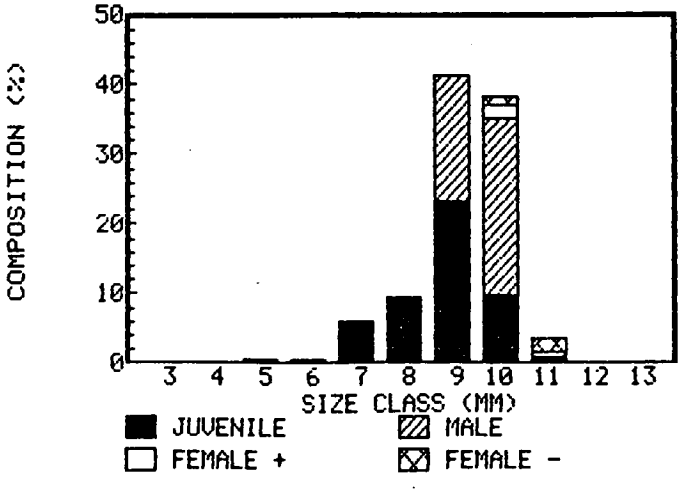
J)


JUNE
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

K)


JULY
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

L)


AUGUST
COMPOSITION (%)
50
40
30
20
10
0
3 4 5 6 7 8 9 10 11 12 13
SIZE CLASS (MM)
JUVENILE
MALE
FEMALE +
FEMALE -

adults of 8.0-8.9mm were taken and during November, December and January a few adults 7.0-7.9mm in length were recorded. The average length of males in each month, calculated from the size class data, is depicted in Fig. 4.18. Despite large confidence intervals, due to low n values in September, October and March, the average length of males was found to be lower during late spring and summer than during winter and early spring. Detailed examination of female breeding is dealt with in Chapter 5.

4.3.7 DIEL DISTRIBUTION

4.3.7.1 Variation in Species Abundance

The number of species collected during the night was consistently higher than in the daytime. Several species records obtained during these 24-hour sampling periods represent the only record of the species from the study site (Table 4.3). A complete list of species present and their densities in each 24-hour sampling session is provided in Appendix B4, together with tidal and daylength data. The densities of T.sp.2, A.mixta australis and P.rufa (all stages) caught at each site for the October, January and April 24-hour sampling sessions are plotted in Figs. 4.19, 4.20 and 4.21 respectively. Numbers were low at site B for all species, but frequently were higher at night than during the day, which may indicate nocturnal transfer of species across the bay.

Diel variation in the numbers of T.sp.2, A.mixta australis and P.rufa caught was observed. The timing of peaks and lows was different for each species, and in the case of A.mixta australis in January, different at each site.

a) Tenagomysis sp.2

(i) October: Peak abundance at 0600hrs; just after sunrise and at high tide (MLHW). Low abundance overnight at site A, but only caught at night at site C (maximum density = $7.6m^{-3}$ at 2100hrs). Tide low overnight.

(ii) January: Peak abundance at 2100hrs (the tide was rising). Abundance greater during the day than at night. The tide was high during the night.

(iii) April: Peak abundance at 1800hrs (sunset) at both sites; the density at site A, $3904m^{-3}$ was the highest recorded at any time at One Tree Point. Second peak at 0600hrs (sunrise) at site A only. Low abundance observed during the night.

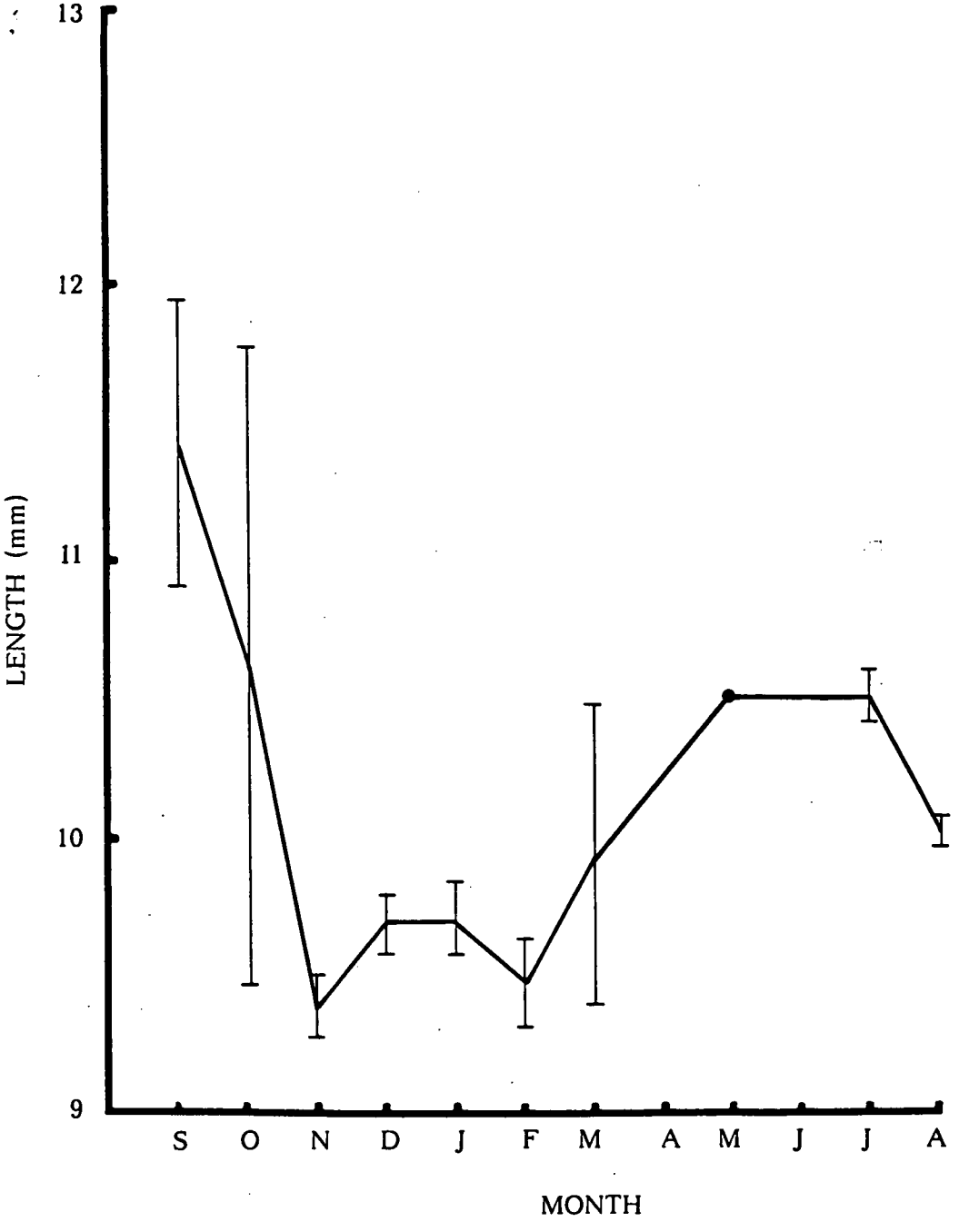
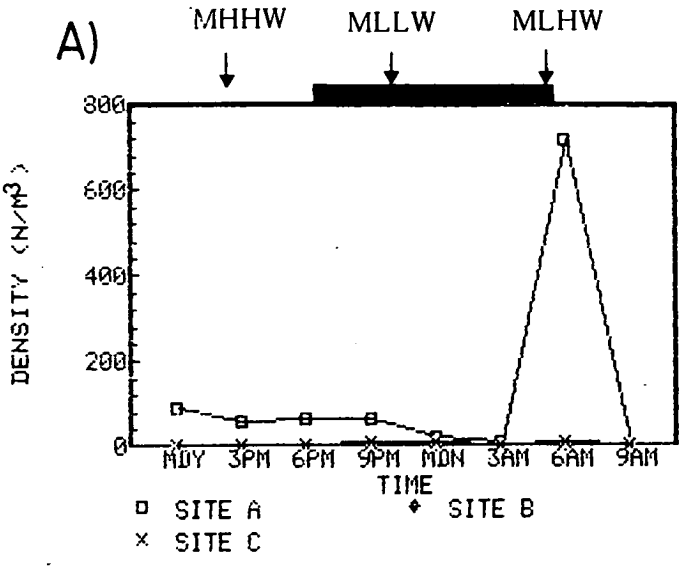
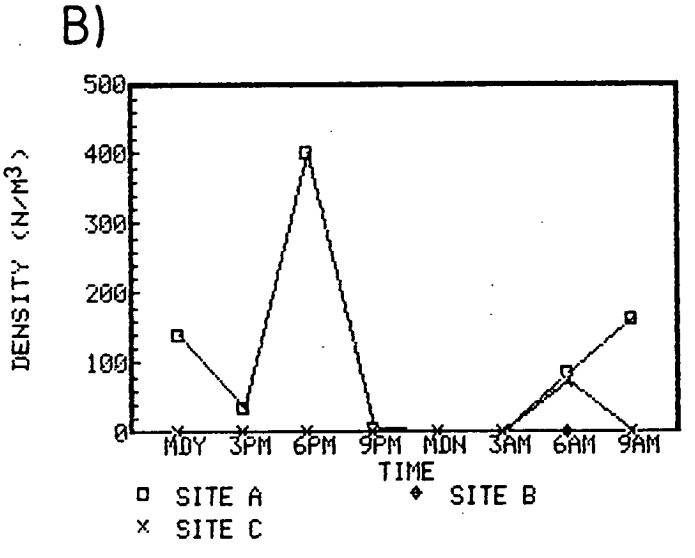
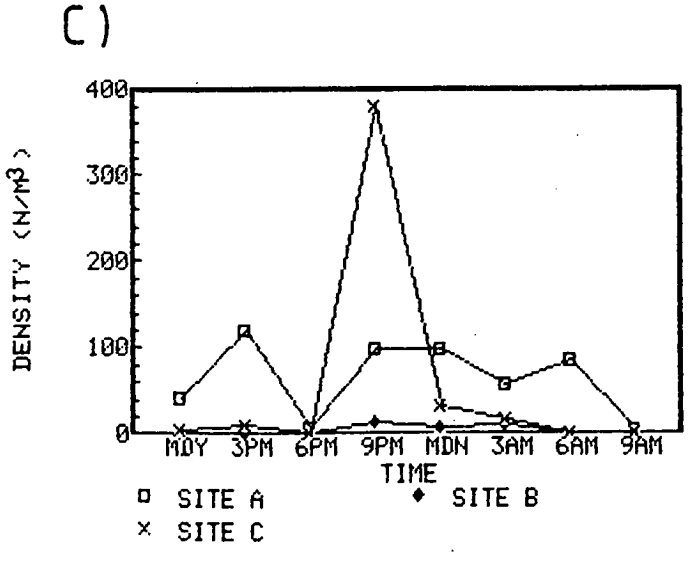


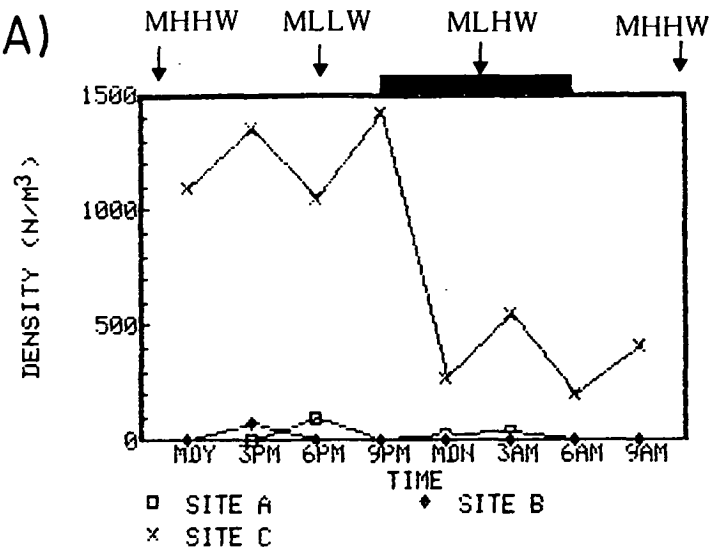
Fig. 4.18 Mean monthly male length ± 95% confidence intervals for Paramesopodopsis rufa (Note that in May n=1).


A)
MHHW
MLLW
MLHW
800
600
400
200
0
DENSITY (N/M3)
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
SITE A
SITE B
SITE C

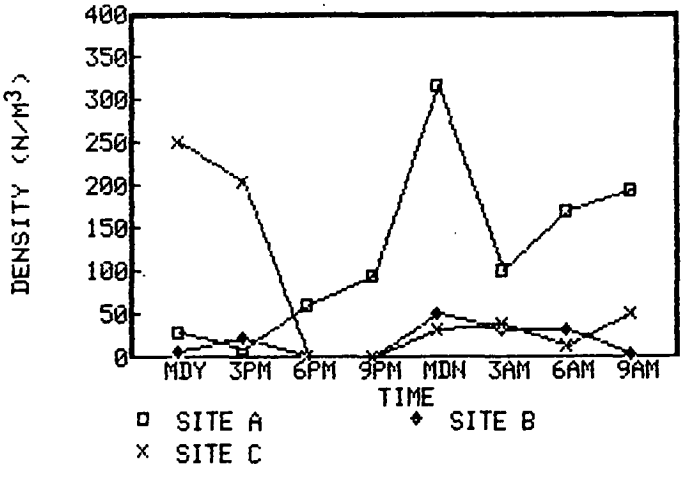

B)
500
400
300
200
100
0
DENSITY (N/M3)
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
SITE A
SITE B
SITE C


C)
400
300
200
100
0
DENSITY (N/M3)
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
SITE A
SITE B
SITE C

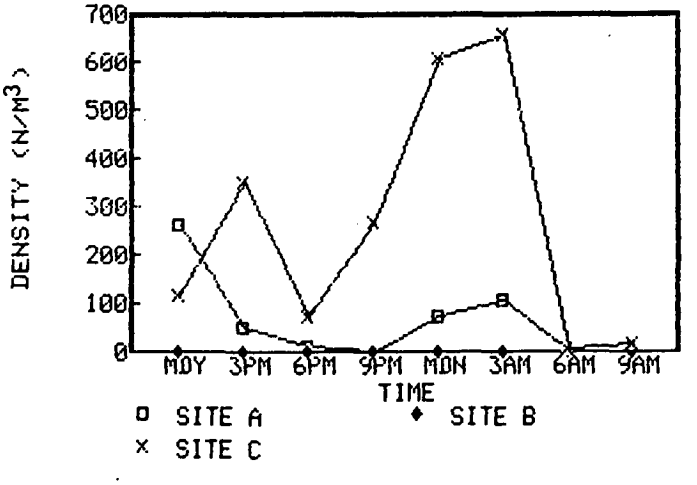
A)


MHHW
MLLW
MLHW
MHHW
1500
1000
500
0
DENSITY (N/M3)
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
SITE A
SITE B
SITE C

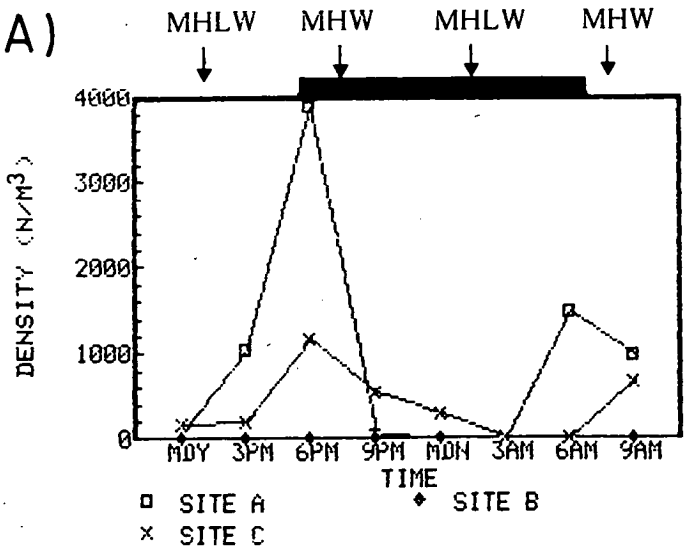
B)


400
350
300
250
200
150
100
50
0
DENSITY (N/M3)
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
SITE A
SITE B
SITE C

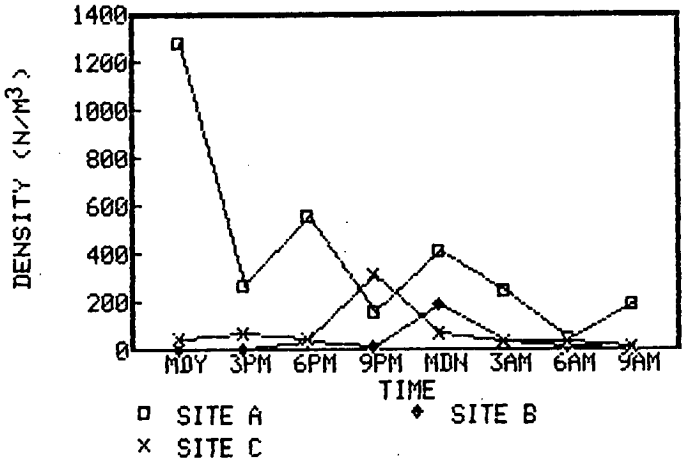
C)


700
600
500
400
300
200
100
0
DENSITY (N/M3)
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
SITE A
SITE B
SITE C

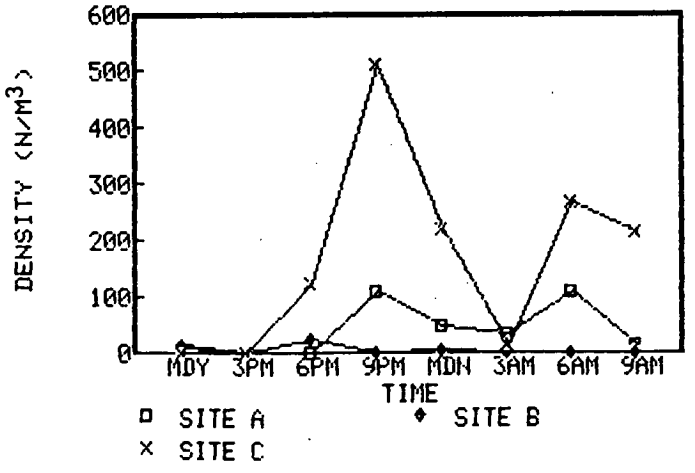
A)


MHLW
MHW
MHLW
MHW
4000
3000
2000
1000
0
DENSITY (N/M3)
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
SITE A
SITE B
SITE C

B)


1400
1200
1000
800
600
400
200
0
DENSITY (N/M3)
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
SITE A
SITE B
SITE C

C)


600
500
400
300
200
100
0
DENSITY (N/M3)
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
SITE A
SITE B
SITE C

Tidal control of the abundance of T.sp.2 was not clear. Peak abundances were found at high tide in October and April but in January there was very little difference between the abundance at high or low tide. Light appeared to be the controlling factor, with low numbers caught at night but peaks of abundance occurring at either sunset or sunrise, and in April (site A) at both. The results suggest that a crepuscular activity pattern was present with a superimposed tidal pattern.

b) Anisomysis mixta australis

(i) October: Peak abundance at 1800hrs (sunset). Greater numbers were caught during the day compared to the numbers at night. The tide was low overnight and high during the day.

(ii) January: Sites A and C show the exact reverse of each other. This could be explained by the movement of mysids across the bay. However, it seems unlikely that such a mass transfer would have occurred but this possibility needs to be examined further.

(iii) April: Peak abundance at noon, Site A (low tide), but at 2100hrs at site C (after high tide). Abundance was lowest at 0600, 0900 and 2100hrs for site A (high tide) and at 0900 and 0300hrs (low tide) for site C.

The control of diel activity in A.mixta australis remains unclear; no consistent patterns were evident in relation to the tides or to light.

c) Paramesopodopsis rufa

(i) October: Major abundance at 2100hrs (low tide) at site C. At site A the numbers were relatively consistent but lows were observed at 1800 (falling tide), 0900 (rising tide) and 1200hrs (high tide). Numbers were generally higher at night at all sites.

(ii) January: Abundance was high at night at site C from 2100hrs till 0300hrs, with a maximum at 0300hrs (high tide). Low numbers were collected at 0600 (sunrise; rising tide) and 0900hrs (rising tide). At site A, the maximum number were collected at 1200hrs, but a prominent night time peak was also evident.

(iii) April: At both sites there were night-time peaks with a maximum at 2100hrs (high tide) and again at 0600hrs (high tide).

No consistent influence of the tide could be detected, since peak abundances occurred at both low and high tides. However, major abundance peaks were consistently found at night.

4.3.7.2 Variation in the Population Composition During a 24-Hour Period

a) Tenagomysis sp.2 (see Fig. 4.22)

In October, the percentages of juveniles, males and females with or without broods, remained relatively constant throughout the sampling period. A major discrepancy at 0900hrs was probably due to the low total number contributing to this value (n=4). Juveniles dominated the population at all times except for midnight (and 0900hrs), when adults were dominant. Adults were lowest in abundance at 1200hrs.

In January, adults dominated the population except at 1800hrs when juveniles outnumbered adults. Brooding females were dominant in the night-time samples, with a major peak at midnight. Females also dominated the midday population; but at 1500 and 0900hrs, males were dominant.

Juveniles dominated the population at all times in April. The proportion of males present between 0000-0900 was greater than at other times. No overall pattern was observed for diel variation in population structure.

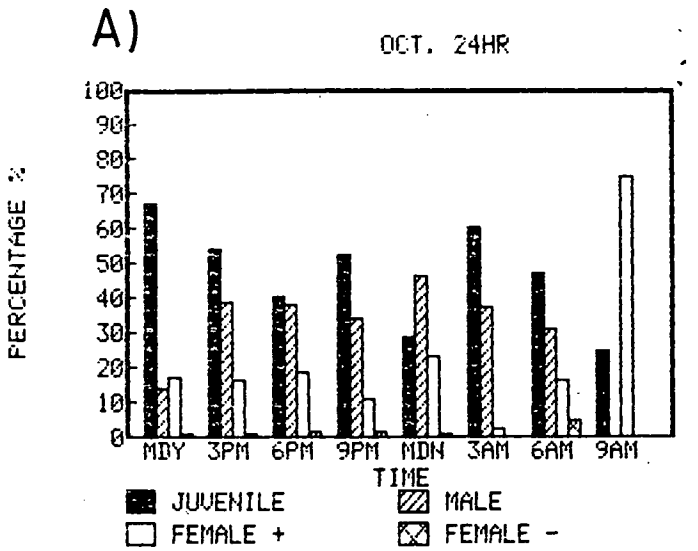
b) Anisomysis mixta australis (see Fig. 4.23)

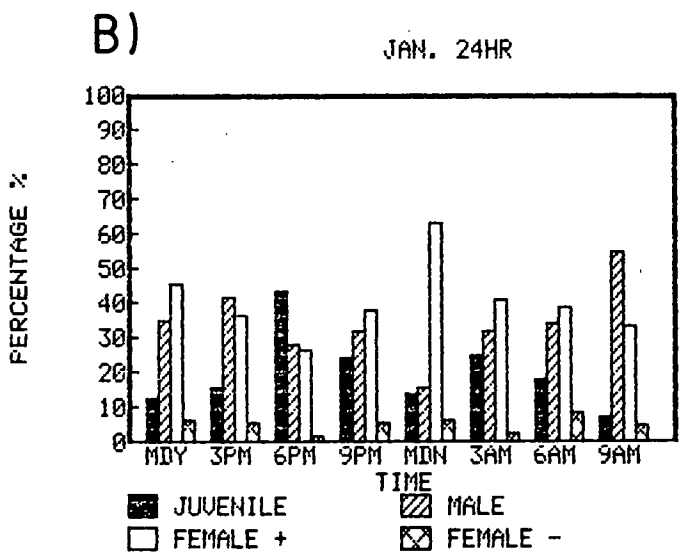
In October, males dominated the population during the daytime, except at 1500hrs when a large number of females without broods were collected. At 2100 and 0000hrs brooding females dominated the population, but the total number of individuals collected at night was very low. Juveniles were collected in larger numbers at 1800, 2100, 0300 and 0600hrs.

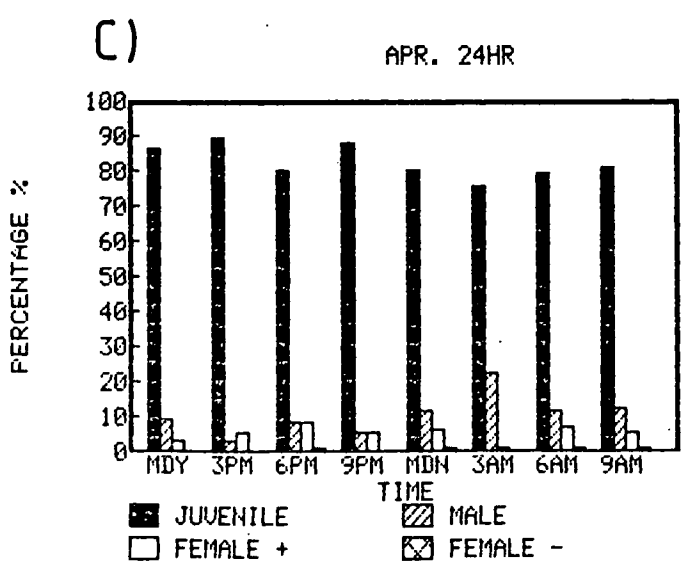
During the January 24-hour sampling period, juveniles were collected in larger numbers at night. Males dominated the population structure at all times except 1200, 1500 and 0300 when brooding females out-numbered males.

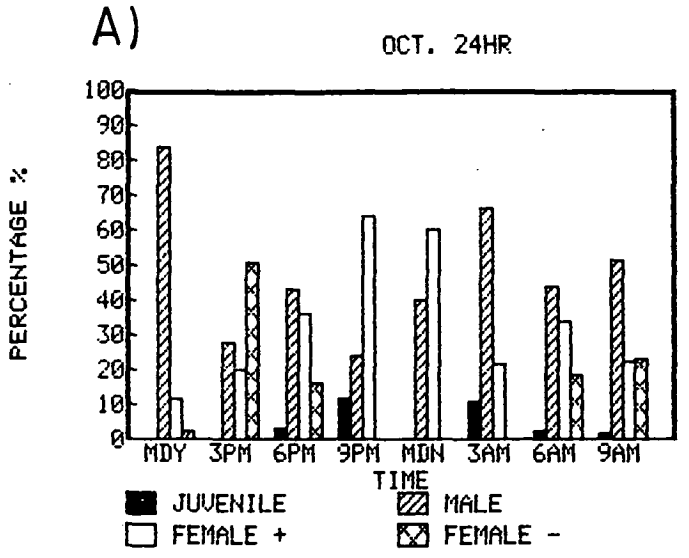
In April, juveniles dominated the population at 1200hrs, but at all other times adults were present in greater numbers than juveniles. Males out-numbered females at 1800hrs, and quite dramatically so at 0300hrs.

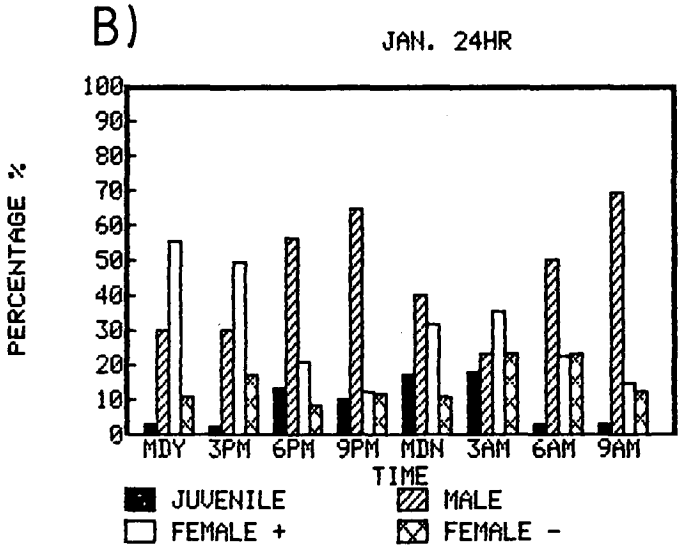
Diel variation in population structure did not appear to follow a set pattern throughout the year.

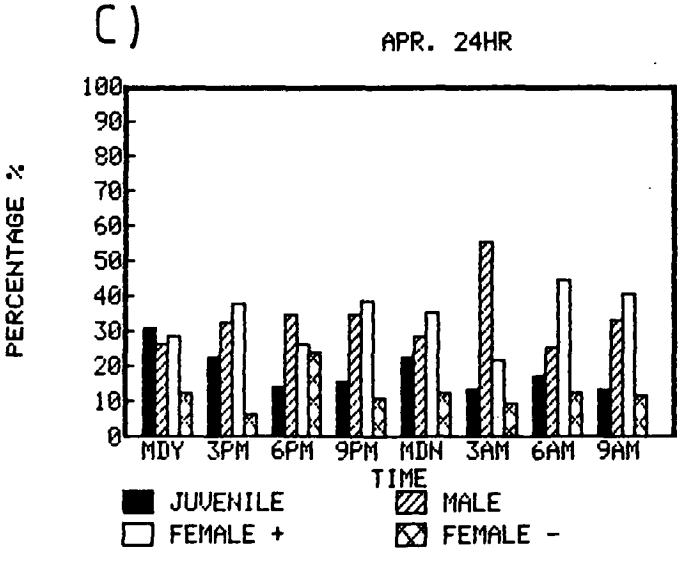

A)
OCT. 24HR
PERCENTAGE %
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
JUVENILE
MALE
FEMALE +
FEMALE -


B)
JAN. 24HR
PERCENTAGE %
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
JUVENILE
MALE
FEMALE +
FEMALE -


C)
APR. 24HR
PERCENTAGE %
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
JUVENILE
MALE
FEMALE +
FEMALE -


A)
OCT. 24HR
PERCENTAGE %
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
JUVENILE
MALE
FEMALE +
FEMALE -


B)
JAN. 24HR
PERCENTAGE %
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
JUVENILE
MALE
FEMALE +
FEMALE -


C)
APR. 24HR
PERCENTAGE %
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
JUVENILE
MALE
FEMALE +
FEMALE -

c) Paramesopodopsis rufa (see Fig. 4.24)

In October, the population structure remained relatively constant throughout the 24-hour sampling period, with the exception of 1800hrs. The dominance of brooding females at 1800hrs was probably due to the low number (n=5) caught at this time.

During the January 24-hour sampling period, juveniles dominated the samples at 1200, 2100, 0000 and 0300hrs. Females with broods outnumbered males at 1500 and 1800hrs, and males were most numerous at 0600 and 0900hrs. During the night and particularly at 0000, females with broods were collected in low numbers.

Juveniles dominated the population in April, except at 1500hrs. Low numbers were thought to be responsible for the structure observed at 1500 and 1200hrs. Few brooding females were collected at night, but males were present in larger numbers at night.

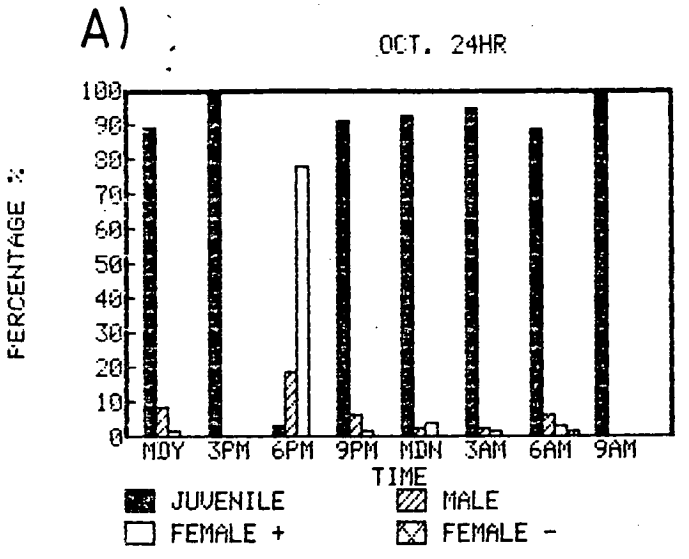
Trends were not clear, but brooding females were collected in lower numbers at night in January and in April.

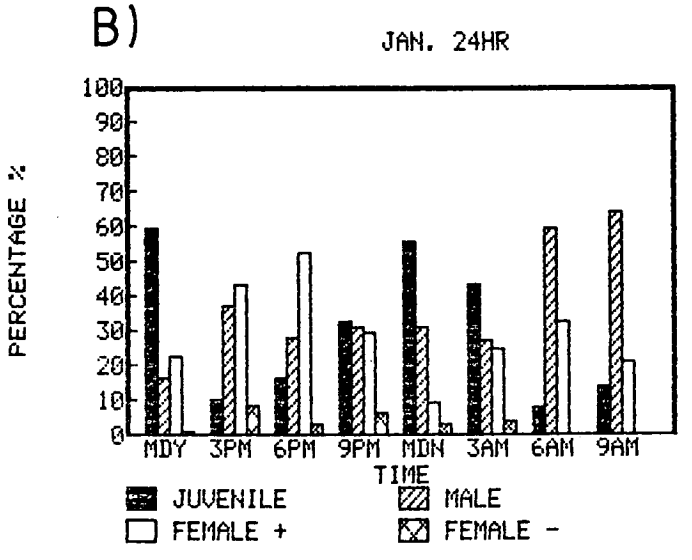
4.4 DISCUSSION

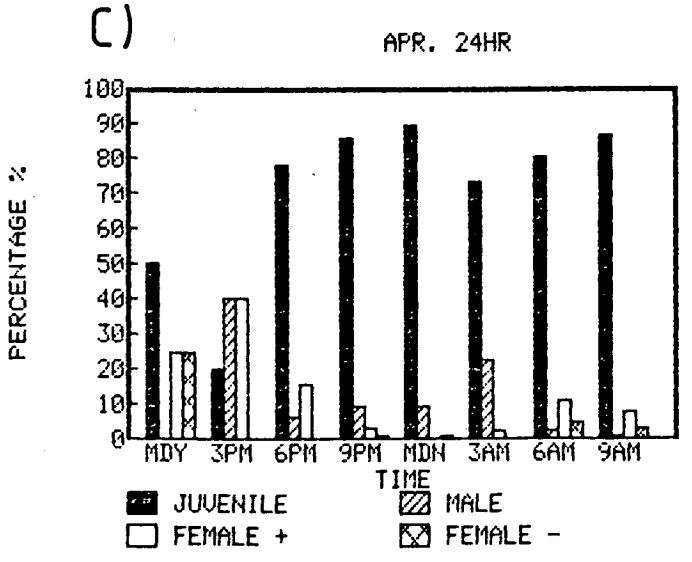
T.sp.2, A.mixta australis and P.rufa at One Tree Point occur in large numbers at the edge of the bay where the algal fringe meets the sand at sites A and C. This zonation pattern could not be correlated to physical parameters such as salinity, temperature, sediment particle size or organic content since they were relatively constant throughout the bay. Furthermore, T.sp.2, A.mixta australis and P.rufa showed preference for particular regions within their habit zone; thus some degree of habitat partitioning was indicated.

The density of T.sp.2, A.mixta australis and P.rufa at sites A and C was frequently over $100m^{-3}$. However, the density in the remainder of the bay (as evidenced by collections from site B) was considerably lower, i.e. generally between $1-10m^{-3}$, although the density at this site was frequently found to increase at night. The maximum density recorded for site B was $192m^{-3}$ at midnight for A.mixta australis. The maximum density recorded for T.sp.2 was $3904m^{-3}$ at 1800hrs in April (site A); for P.rufa $736m^{-3}$ in November (site A) and $1287m^{-3}$ for A.mixta australis in April at 1200hrs (site A).

Overall, the densities of the three species at sites A and C were similar to those of many other shallow-water temperate mysid species elsewhere in the world (Table 4.4). It is noteworthy that the population of Neomysis intermedia in Lake Kasumigaura (Toda et al., 1982) is fished commercially, producing an annual catch of about 2000 metric tons wet weight.


A)
OCT. 24HR
PERCENTAGE %
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
JUVENILE
MALE
FEMALE +
FEMALE -


B)
JAN. 24HR
PERCENTAGE %
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
JUVENILE
MALE
FEMALE +
FEMALE -


C)
APR. 24HR
PERCENTAGE %
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
JUVENILE
MALE
FEMALE +
FEMALE -

From Table 4.4 it is evident that the densities, particularly of T.sp.2, are among the highest reported for mysids.

The results of the 24-hour sampling sessions conducted in the present study showed changes in the abundance of each species at different times. Tidal influence was not consistent and therefore does not appear to be the controlling factor for the three main species. Mauchline (1980) noted that tidal rhythms do not appear to be endogenous among mysid species and although they do not seem to control behaviour, they have been observed to modify behaviour patterns (Dadswell, 1975; Connell, 1974; Wooldridge and Erasmus, 1980). Light, seems to be the most important factor controlling the distribution of mysids in the present study. The importance of light in controlling mysid distribution is well documented (Clutter, 1969; Heubach, 1969; Wilson and Roff, 1973; Teraguchi et al., 1975; Zelickman, 1974; Wittmann 1977). The effect of light on behaviour varies between species; most species appear to be attracted to weak light, but are repelled by strong light (Macquart-Moulin, 1972, 1977b). In the present study, T.sp.2 occurred in very high densities at sunrise or sunset, or both, corresponding to times of low light, but during the night only low densities were found. On the other hand, P.rufa occurred in greater densities at night. Further investigation is needed to determine what happens to the T.sp.2 population at night. Dispersal is indicated, but whether this is in the vertical or horizontal plane, or if individuals merely settle on the bottom at night, cannot be determined by the sampling program conducted here.

The reasons for the increase in the number of P.rufa collected at night also needs further examination. Probably the increase is caused by the population inhabiting the macroalgae during the day moving out towards the edge of the algae and out on to the sand. A net outward movement of the population would account for the increase in the numbers recorded. This has been recorded for Siriella pacifica (Hobson and Chess, 1976).

Activity rhythms are indicated for T.sp.2 and P.rufa, however the situation remains less clear for A.mixta australis. Further detailed sampling is required to examine the activity patterns in all three species. Quite possibly, A.mixta australis may not have an endogenous activity rhythm. Although most of the species examined by other workers have exhibited some endogenous activity rhythm a few, such as Leptomysis gracilis and Siriella jaltensis, have not (Mauchline, 1980).

The activity rhythms of a few species have been observed to differ between males and females. Macquart-Moulin (1973) observed that while females did not exhibit diel vertical migration, the males did. Herman (1963) found female Neomysis americana with broods migrated more regularly

Table 4.4 Examples of mysid density values reported in the literature.

SPECIES	LOCALITY	DENSITY	AUTHOR
Neomysis intermedia	Lake Kasumigaura	Max. 2500 m^{-3} or 10000 m^{-2}	Toda et al. (1982)
N.americana	Indian River Inlet.	Max. 3300 m^{-3}	Hopkins (1965)
N.mercedis	Western Sacremento-San Joaquin Delta	Max. 700 m^{-3}	Siegfried et al. (1979)
N.awatschensis	Sacremento-San Joaquin Estuary	Max. 800 m^{-3}	Heubach (1969)
Mysidopsis bigelow	Hereford Inlet New Jersey, USA	Max. 6583 m^{-3} usually > 100 m^{-3}	Allen (1984)
Mysis mixta	New Hampshire coastal waters	Max. 30 m^{-3}	Grabe and Hatch (1982)
M.relicta	Lake Superior	Mean 261 m^{-2}	Carpenter et al. (1974)
	Lake Huron	Mean 97 m^{-2}	" "
	Lake Ontario	Mean 180 m^{-2}	" "
	Lake Michigan	Mean 188 m^{-2}	Morgan and Beeton (1978)
Gastrosaccus brevifissura	Sundays Estuary S. Africa	Max. 1350 m^{-3}	Wooldridge and Bailey (1982)
Rhopalophthalmus terranatalis	" "	Max. 4100 m^{-3}	" "
Mesopodopsis slabberi	" "	Max. 5950 m^{-3}	" "
	Swartkops Estuary	Max. 19875 m^{-3}	Wooldridge (1983)
	Algoa Bay	Max. 15246 m^{-3}	" "
T.sp.2	One Tree Pt.	Max. 3904 m^{-3}	Present study
A.mixta australis	" "	Max. 1287 m^{-3}	" "
P.rufa	" "	Max. 736 m^{-3}	" "

than the remainder of the population. Variation in the population composition of T.sp.2 during the present study was not consistent. However, in the case of P.rufa, there is an indication that brooding females are less frequently caught at night. The increased population at night appears to be a result of increased numbers of juveniles. If net avoidance was greater during the day than at night, as shown by Fleminger and Clutter (1965) for Metamysidopsis elongata, the reverse situation would be expected for P.rufa. Juveniles, by virtue of their size, would be expected to be less capable of net avoidance than adults, so that the night-time population of P.rufa would be expected to have a larger proportion of adults present, but the opposite was observed. The importance of conducting several 24-hour sessions is stressed, since distribution patterns may vary seasonally (Teraguchi et al., 1975; Lasenby and Langford, 1972). Moreover, if only one 24-hour sampling session was carried out, it would be easy to draw false or misleading conclusions about the population.

Of the species collected at One Tree Point, most occurred in low numbers and appeared to have disaggregated distributions (Mauchline, 1980). However, at other sites on the Tasmanian coast, a few of these species, eg. Tasmanomysis oculata, Prionomysis sp.1, Allomysis sp.1 and Doxomysis sp.1, have been collected in large numbers (see taxonomic section for site locations). Tenagomysis sp.1 is a regular member of mysid samples collected at One Tree Point, but in low densities. The three main species, T.sp.2, A.mixta australis and P.rufa were regularly collected in large numbers and observed forming swarms. Aspects of swarm formation and structure are currently being analyzed for these species (O'Brien, pers. comm.).

Separate abundance peaks were observed for T.sp.2, A.mixta australis and P.rufa. In the summer months (December, January and February), these abundance peaks were dominated by gravid females and mature males, but during the remainder of the year, population peaks were associated with juveniles. T.sp.2 and P.rufa both bred throughout the year, although at a reduced rate over winter, but A.mixta australis appeared to cease breeding over winter. Winter depression of breeding is a common feature of warm and moderately cold temperate environments which experience low seasonal variation (Wittmann, 1984). It has been reported for many Scottish coastal species, including Leptomysis gracilis, L.lingvura (Mauchline, 1969a), Mysidopsis gibbosa (Mauchline, 1970b), Neomysis integer (Mauchline, 1971b), Paramysis arenosa (Mauchline, 1971a), Praunus flexuosus (Mauchline, 1971c), P.inermis (Mauchline, 1965), Schistomysis kervillei (Mauchline, 1971d), and also for Rhopalophthalmus brisbanensis and G.(H.)dakini in the Brisbane River, Australia (Hodge, 1963b), as well as

many other species listed in Mauchline (1980; Table XXXIV).

Owing to the asynchronous breeding, it is difficult to determine exactly how many generations are produced by the species examined here, but the population dynamics of these species appear to be quite similar to that reported for the majority of temperate mysid species which produced three per year (Mauchline, 1980).

In conclusion, the three dominant mysid species at One Tree Point all occur within the same zone; habitat partitioning within this zone and differences in diel activity patterns were evident. Furthermore, the major peaks of abundance for each species generally were temporally separate, but the basic breeding pattern appeared fairly similar in the three species.

4.5 SUMMARY

1. The population structure and dynamics of a shallow coastal mysid community was examined over a 12 month period, including three 24-hour sampling sessions.

2. Fourteen mysid species were recorded; three, T.sp.2, A.mixta australis and P.rufa dominated the mysid community in terms of abundance. The population structure and dynamics of these three species was examined in detail.

3. T.sp.2 was the most abundant mysid species (mean density $32.4m^{-3}$) followed by A.mixta australis (mean density $20.5m^{-3}$) and P.rufa (mean density $11.3m^{-3}$). The maximum density recorded for T.sp.2 was $3904m^{-3}$; for A.mixta australis $1287m^{-3}$;and $736m^{-3}$ for P.rufa. The major peaks of abundance for each species were temporally separate.

4. T.sp2, A.mixta australis and P.rufa occurred in large numbers associated with the algal fringe on either side of the bay. Habitat partitioning within this zone of occurrence was evident.

5. Diel distribution of the mysid community was examined. Peaks of abundance for T.sp.2 were associated with sunrise and or sunset. P.rufa was caught in greater numbers at night. No consistent diel activity pattern was observed for A.mixta australis.

6. T.sp.2, A.mixta australis and P.rufa bred intensively from spring till late autumn. Breeding was continuous for T.sp.2 and P.rufa but at a reduced rate during winter. A.mixta australis appeared to cease breeding over winter.

CHAPTER 5

REPRODUCTION

5.1 INTRODUCTION

In the Mysidacea, the ovary is located in the thorax lying above the alimentary canal. Developing eggs within the ovarian tubes are often easily visible through the transparent carapace of the female. Development of eggs in the ovary is synchronized with the development of larvae in the brood pouch (Wittmann, 1981a). After release of the young in the brood pouch, the female moults, copulates, and this provides the stimulus for extrusion of unfertilized eggs into the brood pouch where fertilization occurs. This entire sequence of events usually occurs in one or possibly two nights (Wittmann, 1981a). Wittmann (1982) later reported that when female Leptomysis lingvura were ready to copulate, they release an extremely short-lived sexual attractant (about 2min at 22°C); this resulted in intensive searching behaviour by the male. The release of sexual attractants by female mysids had previously been hypothesized by Clutter (1967). Since the female is receptive for only a short period of time after moulting, the release of a sexual attractant would certainly improve the chances of fertilization taking place. Further details of reproduction in the Mysidacea are reviewed by Mauchline (1980) and Wittmann (1981a; 1982).

Mysids, as with all peracaridan crustacea, carry their developing young in the brood pouch (also known as the marsupium). Three main stages are recognized during larval development according to Wittmann (1981a), i.e. the embryonic, nauplioid and post-nauplioid stages. Young are released from the brood at the end of the post-nauplioid stage. Immediately after their release, the young moult to the juvenile stage resembling a miniature adult (1.5-3mm in length). The embryonic, nauplioid and post-nauplioid stages defined in detail by Wittmann (1981a) are more or less identical to the commonly used terms in the literature, i.e. egg, eyeless and eyed larvae respectively (Wittmann, 1981b). Provided that breeding is highly asynchronous, it is possible by recording the number of females carrying young at different stages of development to estimate (±10%) the proportion of the total brood life spent in each developmental stage (Mauchline, 1973b; Wittmann, 1981b, 1984). The proportion of time spent in each developmental stage varies between 25-40% for the egg (embryonic) stage; 30-45% for the eyeless (nauplioid) stage and 15-30% for the eyed

(post-nauplioid) stage (Wittmann, 1984).

Several factors have been observed to affect the number of young present in the brood pouch, including female body length, egg size, latitude and season (Mauchline, 1980). Importantly, the duration of the development of the young in the brood pouch is related to environmental temperature (Ishikawa and Oshima, 1951; Mauchline, 1965, 1980; Wittmann, 1981b, 1984). Long development times have been reported for species inhabiting cold-water environments, such as Boreomysis arctica (Jepsen, 1965) and Mysis relicta (Lasenby and Langford, 1972); the longest development time documented is for the bathypelagic species Gnathophausia ingens estimated to be 530 days (Childress and Price, 1978). Generally the duration of marsupial development is less than one month for species living in temperate waters, with strong seasonal variation (Wittmann, 1984). The shortest development time reported is 4 days for Mesopodopsis orientalis at 25-29°C (Nair, 1939). Recently, Wittmann (1984), has shown that both temperature and egg size have a major influence on determining the length of brood life, and his paper has provided a valuable review on the current knowledge of marsupial development in mysids.

5.2 MATERIALS AND METHODS

The broods of gravid Tenagomysis sp.2, Anisomysis mixta australis and Paramesopodopsis rufa females were examined throughout the year from the sample collected from One Tree Point. Collection methods and description of the study site are given in Section 4.2.

Female length, number, size and stage of development (egg, eyeless or eyed larvae) present in the brood pouch were recorded for all females with unruptured brood pouches in each monthly sample. Additionally, the length of females and the number of eggs developing in the ovaries of at least 23 females of each species were recorded. Female length was measured as in Section 4.2.6. Larval size was measured as diameter for the egg stage, and length from the terminal to frontal tip of the body for eyeless and eyed stages. All measurements were made using a binocular microscope fitted with an ocular micrometer.

Distinction between the three developmental stages was according to Mauchline (1980) and is summarized here:

Stage 1 : "egg-like" embryo - still within the egg membrane. This membrane is punctured at the end of this stage when hatching into the second stage occurs.

Stage 2 : eyeless larvae - the antennae and thoracic appendages develop, and pigmentation of the eyes occurs. This stage terminates in a moult.

Stage 3 : eyed larvae - the eyes of the moulted larvae are on stalks. The statolith is not present in the statocyst. The larvae are released from the brood pouch at this stage, and moult into the juvenile stage.

Since these three stages virtually correspond to the stages defined by Wittmann (1981a), the earlier more widely used terms have been used here i.e. egg, eyeless and eyed larvae.

5.2.1 STATISTICAL ANALYSIS AND DATA PRESENTATION

Linear regressions between female length and number of eggs, eyeless and eyed larvae for each month, season and for the year were calculated for T.sp.2, A.mixta australis and P.rufa. T-tests comparing the mean length and number of young in each season for these species were also calculated. Formulae and probability tables used were according to Mather (1973).

Egg ratio was calculated as the ratio of the number of young in the brood pouch to the total number of individuals in the population (Toda et al., 1982).

Inter-moult growth of females with broods was estimated from the mean increase in length of females carrying each larval stage (Mauchline, 1973a).

Estimation of brood duration was calculated using the equation Wittmann (1984) proposed as a unifying model for all mysids:

$$\ln(D_i) = a + \alpha \ln(D_e) + \frac{\mu}{R}(1/T)$$

where D_i = incubation time in days

D_e = egg diameter in mm

T = absolute temperature ^{o}K

a = -27.49±2.02 (constant)

α = 0.795±0.121 (constant)

μ = 17795±1130 $cal.mol^{-1}$ (temperature characteristic)

R = 1.986 $cal.mol^{-1}.K^{-1}$ (gas constant)

with 99% confidence intervals:

$$\ln(1) = \pm\sqrt{(0.54 + [0.26\ln(D_e) + 0.13]^2 + [(1217/T) - 4.24]^2}$$

Abbreviations and notation in Figures and Tables in this chapter are as follows:

SP = spring (September, October, November)
SU = summer (December, January, February)
AU = autumn (March, April, May)
WI = winter (June, July, August)
$\bar{x}$ = mean
S.D. = standard deviation
CL = lower confidence limit
CU = upper confidence limit
r = regression coefficient
P = probability

5.3 RESULTS

5.3.1 SEASONAL VARIATION IN FEMALE BODY LENGTH

5.3.2.1 *Tenagomysis* sp.2

Gravid females were collected throughout the year, with the exception of September (where only one juvenile individual of this species was collected). The body length of individuals ranged between 5.3mm (March) to 10.9mm (November) and their mean size varied seasonally. Variation in the size range of the gravid females was found; the greatest range occurred in spring, summer (both with a range of 3.9mm) and autumn (range = 3.7mm), but a range of only 1.8mm was observed in winter (Table 5.1). Large gravid females (>9.5mm) occurred in spring and summer with the largest females found during the spring. During autumn and winter the largest gravid female found, measured 9.0 and 8.6mm respectively.

The mean length of females carrying broods of each developmental stage throughout the year are provided in Appendix C1. Seasonal and annual means are presented in Fig. 5.1, and the results of t-tests comparing the female length in all seasons are given in Table 5.2. In all cases, the mean length of females was significantly greater in spring. In addition, the mean female length in summer was markedly greater than in autumn and winter, but there was no significant difference evident between female mean length in autumn and winter.

Overall, the annual mean length of females carrying eggs ($\bar{x}$=7.72mm) was significantly smaller than those with eyeless larvae ($\bar{x}$=7.87mm), which, in turn, were significantly smaller than those with eyed larvae ($\bar{x}$=8.20mm) (Table 5.3)

Table 5.1 Size range of brooding Tenagomysis sp.2 females throughout the year.

MONTH	SIZE RANGE OF FEMALE (mm) EGGS	EYELESS	EYED	TOTAL	SEASONAL RANGE
September	-	-	-	-	Spring:
October	7.1-9.2	8.0-9.0	8.5	7.1-9.2	7.0-10.9
November	7.0-10.9	7.3-10.5	7.9-10.1	7.0-10.9	(=3.9mm)
December	6.9-9.4	6.6-9.5	7.2-9.7	6.6-9.7	Summer:
January	7.0-8.5	6.3-10.0	7.2-10.1	6.3-10.1	6.2-10.1
February	7.0-8.5	6.2-9.4	6.5-9.5	6.2-9.5	(=3.9mm)
March	7.0-8.6	5.3-8.8	7.1-9.0	5.3-9.0	Autumn:
April	6.4-8.1	6.1-8.5	7.5-8.0	6.1-8.5	5.3-9.0
May	6.3-8.5	6.6-8.7	7.0-9.0	6.3-8.7	(=3.7mm)
June	7.0-8.5	7.0-8.5	7.0-8.5	7.0-8.5	Winter:
July	6.8-8.6	7.0-8.5	7.0-8.4	6.8-8.6	6.8-8.6
August	6.8-8.0	7.0-8.6	7.0-8.5	6.8-8.6	(=1.8mm)
Yearly range	6.3-10.9	5.3-10.5	6.5-10.1	5.3-10.9 (=5.6mm)	

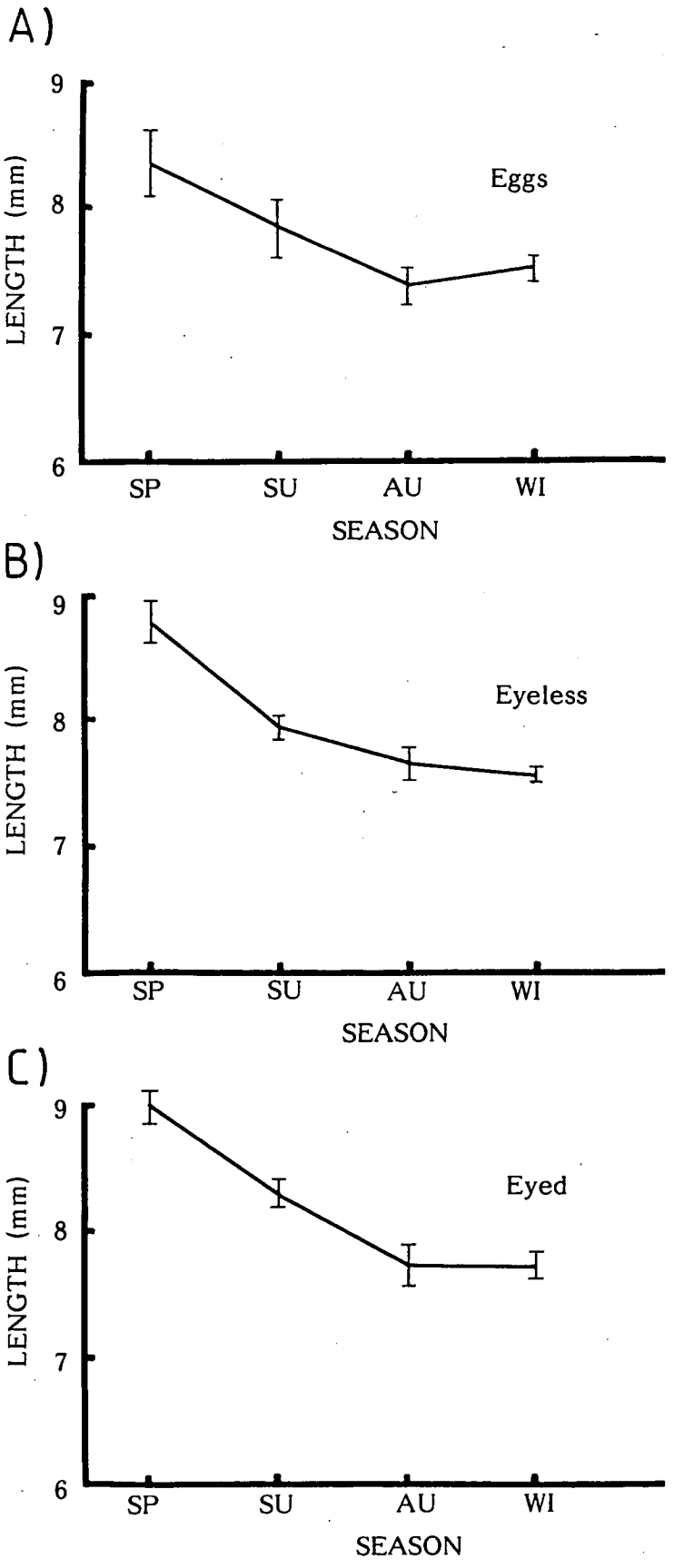

A)
LENGTH (mm)
9
8
7
6
Eggs
SP
SU
AU
WI
SEASON
B)
LENGTH (mm)
9
8
7
6
Eyeless
SP
SU
AU
WI
SEASON
C)
LENGTH (mm)
9
8
7
6
Eyed
SP
SU
AU
WI
SEASON

Table 5.2 Seasonal comparison of a) the mean length of gravid females, and b) the mean number of young per brood carried by *Tenagomysis sp.2*. (Means are plotted in Figs. 5.1 & 5.5 respectively, and the data located in Appendix C1).*

	SP v SU	SP v AU	SP v WI	SU v AU	SU v WI	AU v WI
A)						
Length of ♀ with eggs	$t_{90}=2.76$ p<0.01 SP>SU	$t_{128}=7.11$ p<0.001 SP>AU	$t_{146}=7.22$ p<0.001 SP>WI	$t_{108}=3.66$ p<0.001 SU>AU	$t_{126}=3.22$ p<0.01 SU>WI	$t_{164}=1.89$ p>0.05 AU=WI
Length of ♀ with eyeless	$t_{244}=17.51$ p<0.001 SP>SU	$t_{164}=11.07$ p<0.001 SP>AU	$t_{244}=17.51$ p<0.001 SP>WI	$t_{276}=3.35$ p<0.001 SU>AU	$t_{356}=6.23$ p<0.001 SU>WI	$t_{276}=1.43$ p>0.1 AU=WI
Length of ♀ with eyed	$t_{185}=6.37$ p<0.001 SP>SU	$t_{66}=12.38$ p<0.001 SP>AU	$t_{99}=15.71$ p<0.001 SP>WI	$t_{173}=4.35$ p<0.001 SU>AU	$t_{206}=6.44$ p<0.001 SU>WI	$t_{87}=0.21$ p>0.8 AU=WI
B)						
Number of eggs/ brood	$t_{90}=5.83$ p<0.001 SP>SU	$t_{128}=11.22$ p<0.001 SP>AU	$t_{146}=26.89$ p<0.001 SP>WI	$t_{108}=4.03$ p<0.001 SU>AU	$t_{126}=8.58$ p<0.001 SU>WI	$t_{164}=5.74$ p<0.001 AU>WI
Number of eyeless/ brood	$t_{244}=20.11$ p<0.001 SP>SU	$t_{164}=17.98$ p<0.001 SP>AU	$t_{244}=29.97$ p<0.001 SP>WI	$t_{276}=0.23$ p>0.8 SU=AU	$t_{356}=12.56$ p<0.001 SU>WI	$t_{276}=10.64$ p<0.001 AU>WI
Number of eyed/ brood	$t_{185}=10.51$ p<0.001 SP>SU	$t_{66}=11.4$ p<0.001 SP>AU	$t_{99}=17.64$ p<0.001 SP>WI	$t_{173}=2.53$ p<0.02 SU>AU	$t_{206}=6.92$ p<0.001 SU>WI	$t_{87}=3.36$ p<0.001 AU>WI

* The notation used in this table is as follows, eg. SP>SU implies the mean value for spring is significantly greater than the summer mean. SP=SU indicates no significant difference present.

Table 5.3 T-tests comparing the annual mean length of female and annual mean number of young per brood for females carrying different larval stages of A) Tenagomysis sp.2, B) Anisomysis mixta australis and C) Paramesopodopsis rufa.

	EGGS vs EYELESS	EGGS vs EYED	EYELESS vs EYED
A) Tenagomysis sp.2			
Mean length of female	$t_{780}=2.79$ $p<0.01$ (significant)	$t_{532}=7.81$ $p<0.001$ (significant)	$t_{798}=6.42$ $p<0.001$ (significant)
Mean number of young/brood	$t_{780}=1.96$ $p=0.05$ (significant)	$t_{532}=1.99$ $p<0.05$ (significant)	$t_{798}=4.59$ $p<0.001$ (significant)
B) Anisomysis mixta australis			
Mean length of female	$t_{325}=1.76$ $p>0.05$ (not signif.)	$t_{257}=1.07$ $p>0.2$ (not signif.)	$t_{348}=0.69$ $p>0.4$ (not signif.)
Mean number of young/brood	$t_{325}=1.89$ $p>0.05$ (not signif.)	$t_{257}=3.19$ $p<0.01$ (significant)	$t_{348}=1.71$ $p>0.05$ (not signif.)
C) Paramesopodopsis rufa			
Mean length of female	$t_{186}=3.61$ $p<0.001$ (significant)	$t_{143}=4.03$ $p<0.001$ (significant)	$t_{165}=0.72$ $p>0.4$ (not signif.)
Mean number of young/brood	$t_{186}=1.26$ $p>0.2$ (not signif.)	$t_{143}=1.89$ $p>0.05$ (not signif.)	$t_{165}=0.82$ $p>0.4$ (not signif.)

5.3.1.2 *Anisomysis mixta australis*

Gravid females were collected from September-May; none was collected in the winter months June-August. Female body length ranged between 4.5mm (March) and 8.7mm (November). The greatest size range was observed in summer with a range of 3.8mm compared to 3.1mm in spring and only 2.6mm in autumn (Table 5.4). Large gravid females (>7.5mm) occurred in spring and summer, but not in autumn. No gravid females less than 6.1mm in length were found in September and October. In all other months, gravid females smaller than 6.1mm were found, with the smallest individuals found in February and March.

The mean length of females with each type of larvae throughout the year are given in Appendix C2. Seasonal and annual means are presented in Fig. 5.2, and the results of t-tests comparing the seasonal means are given in Table 5.5. Females in spring were significantly longer than those in summer and autumn. No statistical difference in the length of females with eggs or eyeless larvae was observed between summer and autumn. However, the females with eyed larvae were substantially longer in summer than during autumn. The average length of females throughout the year with eggs ($\bar{x}$=6.05mm), eyeless ($\bar{x}$=6.22mm) and eyed larvae ($\bar{x}$=6.16mm) were not significantly different from each other (Table 5.3).

5.3.1.3 *Paramesopodopsis rufa*

Gravid females were collected throughout most of the year, although in very low numbers from April to August. None was collected in June. Ovigerous females ranged in length from a minimum of 8.5mm to a maximum of 13.9mm both in January. The greatest size range therefore occurred during summer, with a range of 5.4mm. Spring females also displayed a large size range (4.3mm), but during autumn and winter a range of only 1.6 and 1.7mm respectively was observed (Table 5.6). Large gravid females (>12mm) only occurred in spring and summer.

Seasonal variation in the mean length of females with each stage of larval development throughout the year is provided in Appendix C3. Seasonal and annual means are presented in Fig. 5.3, and the results of t-test comparisons given in Table 5.7. No significant difference between the length of females with eggs was apparent between spring and summer, but the females carrying eyeless and eyed larvae were considerably longer in spring than in summer or autumn. Females with eggs in winter were significantly longer than those with eggs in spring or summer. This probably does not reflect the true situation, since the number of females contributing to the

Table 5.4 Size range of brooding Anisomysis mixta australis females throughout the year.

MONTH	SIZE RANGE OF FEMALE (mm) EGGS	EYELESS	EYED	TOTAL	SEASONAL RANGE
September	6.2-7.3	6.1-7.9	6.5-7.5	6.1-7.9	Spring:
October	6.8-7.5	6.8-7.8	7.0-7.6	6.8-7.8	5.6-8.7
November	5.6-8.7	6.0-8.2	6.8-7.8	5.6-8.7	(=3.1mm)
December	6.3	5.5	-	5.5-6.3	Summer:
January	5.0-6.5	5.2-7.2	5.0-8.4	5.0-8.4	4.6-8.4
February	4.9-6.8	4.6-6.7	4.7-8.1	4.6-8.1	(=3.8mm)
March	4.8-6.8	4.5-6.5	5.3-6.0	4.5-6.8	Autumn:
April	5.0-6.4	5.0-7.1	5.0-6.2	5.0-7.1	4.5-7.1
May	5.8	5.0-6.0	5.1-6.0	5.0-6.0	(=2.6mm)
Total range	4.8-8.7	4.5-8.2	4.7-8.4	4.5-8.7 (=4.2mm)	

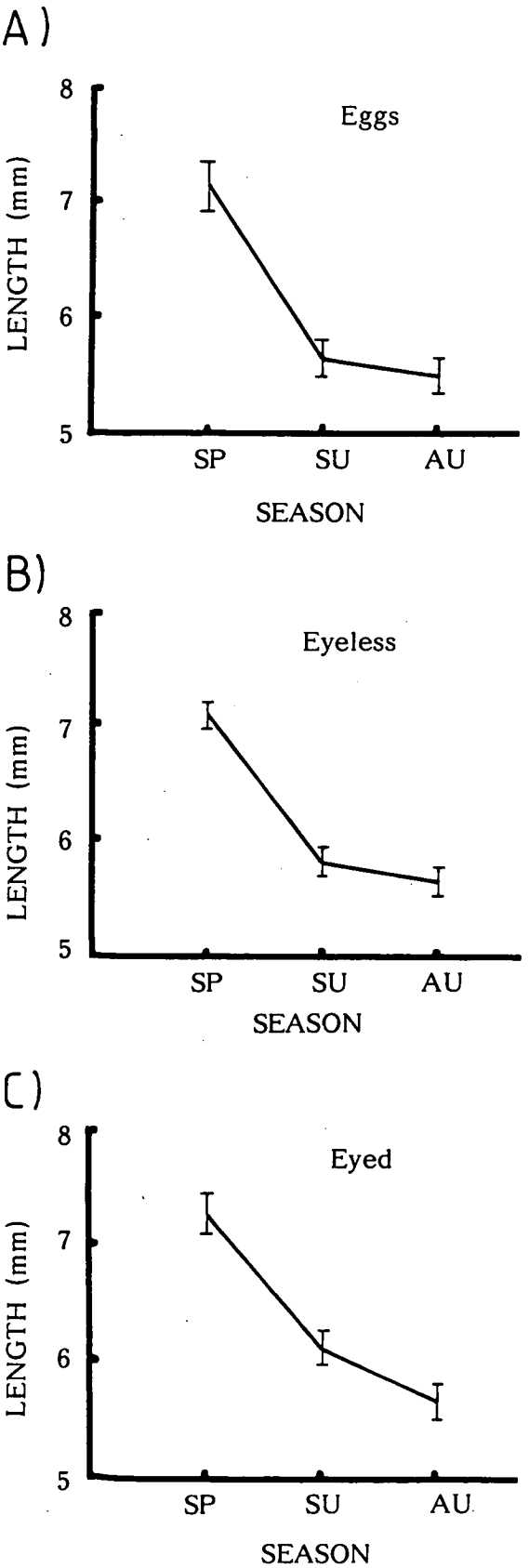

A)
Eggs
LENGTH (mm)
8
7
6
5
SP
SU
AU
SEASON
B)
Eyeless
LENGTH (mm)
8
7
6
5
SP
SU
AU
SEASON
C)
Eyed
LENGTH (mm)
8
7
6
5
SP
SU
AU
SEASON

Table 5.5 Seasonal comparison of a) the mean length of gravid females, and b) the mean number of young per brood carried by Anisomysis mixta australis. (Means are plotted in Figs. 5.1 & 5.5 respectively, and the data located in Appendix C2).*

	SP v SU	SP v AU	SU v AU
A)			
Length of ♀ with eggs	$t_{78}=11.84$ $p<0.001$ SP>SU	$t_{72}=12.77$ $p<0.001$ SP>AU	$t_{80}=1.45$ $p>0.1$ SU=AU
Length of ♀ with eyeless	$t_{151}=15.67$ $p<0.001$ SP>SU	$t_{130}=17.09$ $p<0.001$ SP>AU	$t_{131}=1.93$ $p=0.05$ SU>AU
Length of ♀ with eyed	$t_{113}=6.05$ $p<0.001$ SP>SU	$t_{40}=14.39$ $p<0.001$ SP>AU	$t_{123}=3.15$ $p<0.01$ SU>AU
B)			
Number of eggs/brood	$t_{78}=5.3$ $p<0.001$ SP>SU	$t_{72}=4.9$ $p<0.001$ SP>AU	$t_{80}=0.19$ $p>0.8$ SU=AU
Number of eyeless/ brood	$t_{151}=6.29$ $p<0.001$ SP>SU	$t_{130}=3.94$ $p<0.001$ SP>AU	$t_{131}=2.49$ $p<0.02$ SU>AU
Number of eyed/brood	$t_{113}=0.20$ $p>0.8$ SP=SU	$t_{40}=2.03$ $p<0.05$ SP>AU	$t_{123}=2.08$ $p<0.05$ SU>AU

* The notation used in this table is as follows, eg. SP>SU implies the mean value for spring is significantly greater than the summer mean. SP=SU indicates no significant difference present.

Table 5.6 Size range of gravid Paramesopodopsis rufa females throughout the year.

MONTH	SIZE RANGE OF FEMALE (mm) EGGS	EYELESS	EYED	TOTAL	SEASONAL RANGE
September	10.5-12.2	10.3-12.6	10.1-13.4	10.1-13.4	Spring:
October	10.6-11.4	10.1	-	10.1-11.4	9.1-13.4
November	9.1-11.5	9.7-13.4	10.5-12.8	9.1-13.4	(=4.3mm)
December	9.3-11.3	9.3-12.4	9.7-12.1	9.3-12.4	Summer:
January	8.6-11.2	8.5-12.0	9.5-13.9	8.5-13.9	8.5-13.9
February	10.5	10.5	10.5	10.5	(=5.4mm)
March	10.5	9.0-10.5	9.3-10.6	9.0-10.6	Autumn:
April	-	9.0	-	9.0	9.0-10.6
May	-	-	9.5	9.5	(=1.6mm)
June	-	-	-	-	Winter:
July	10.9-11.7	10.7	-	10.7-11.7	10.0-11.7
August	10.1-11.0	10.0	-	10.0-11.0	(=1.7mm)
Yearly range	8.6-12.2	8.5-13.4	9.3	8.5-13.9 (=5.4mm)	

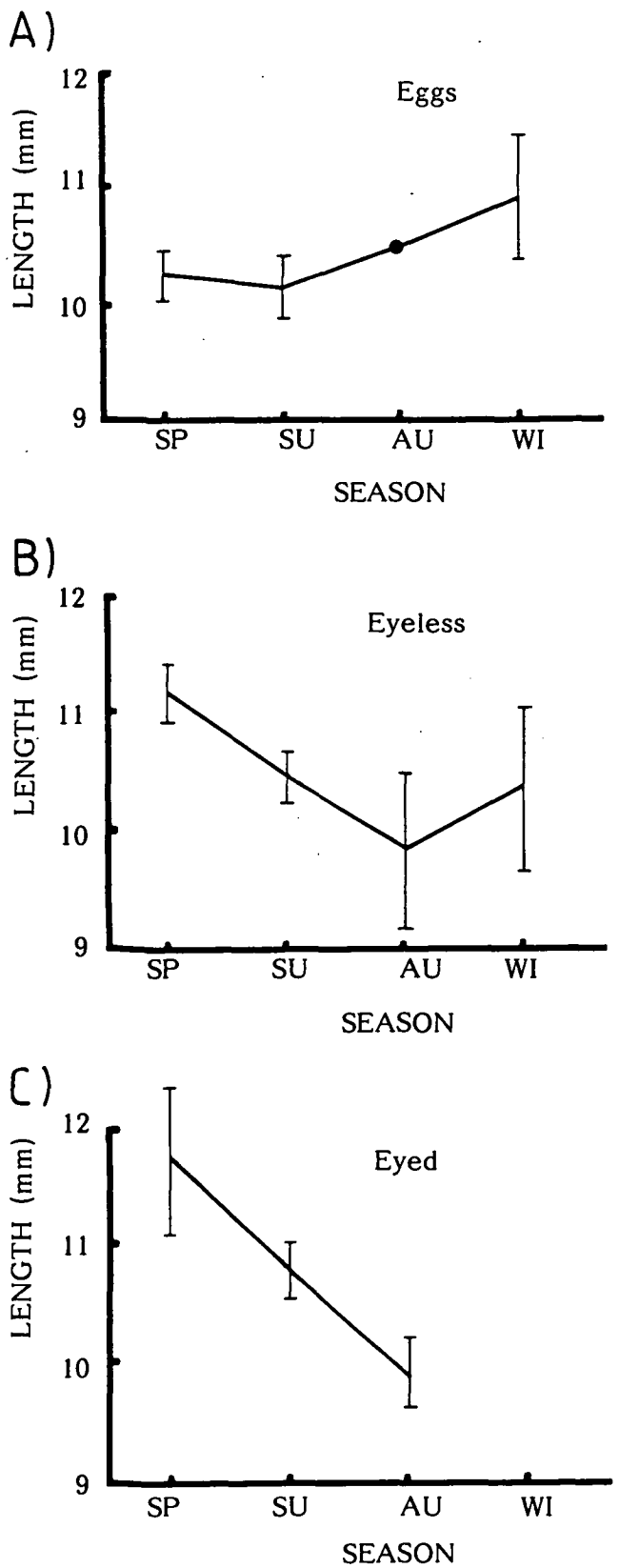

A)
Eggs
LENGTH (mm)
12
11
10
9
SP
SU
AU
WI
SEASON
B)
Eyeless
LENGTH (mm)
12
11
10
9
SP
SU
AU
WI
SEASON
C)
Eyed
LENGTH (mm)
12
11
10
9
SP
SU
AU
WI
SEASON

Table 5.7 Seasonal comparison of a) the mean length of gravid females, and b) the mean number of young per brood carried by Paramesopodopsis rufa. (Means are plotted in Figs. 5.1 & 5.5 respectively, and the data located in Appendix C3).*

	SP v SU	SP v AU	SP v WI	SU v AU	SU v WI	AU v WI
A)						
Length of ♀ with eggs	t_{74}=0.60 p>0.5 SP=SU	-	t_{50}=2.23 p<0.05 SP<WI	-	t_{34}=2.31 p<0.05 SU<WI	-
Length of ♀ with eyeless	t_{96}=4.03 p<0.001 SP>SU	t_{48}=3.25 p<0.01 SP>AU	t_{45}=1.27 p>0.2 SP=WI	t_{56}=1.53 p>0.1 SU=AU	t_{53}=0.14 p>0.8 SU=WI	t_{5}=0.89 p>0.3 AU=WI
Length of ♀ with eyed	t_{52}=3.19 p<0.01 SP>SU	t_{17}=4.5 p<0.001 SP>AU	-	t_{49}=2.92 p<0.01 SU>AU	-	-
B)						
Number of eggs/ brood	t_{74}=4.67 p<0.001 SP>SU	-	t_{50}=6.91 p<0.001 SP>WI	-	t_{34}=3.41 p<0.001 SU>WI	-
Number of eyeless/ brood	t_{96}=3.84 p<0.001 SP>SU	t_{48}=5.68 p<0.001 SP>AU	t_{45}=2.84 p<0.01 SP>WI	t_{56}=4.71 p<0.001 SU>AU	t_{53}=2.12 p<0.05 SU>WI	t_{5}=1.03 p>0.3 AU=WI
Number of eyed/ brood	t_{52}=0.88 p>0.3 SP=SU	t_{17}=4.70 p<0.001 SP>AU	-	t_{49}=4.80 p<0.001 SU>AU	-	-

* The notation used in this table is as follows, eg. SP>SU implies the mean value for spring is significantly greater than the summer mean. SP=SU indicates no significant difference present.

length of the winter value was low (n=6).

Overall, females carrying eggs ($\bar{x}$=10.26mm) were significantly smaller than those carrying eyeless ($\bar{x}$=10.71mm) or eyed ($\bar{x}$=10.82mm) larvae (Table 5.3), but no statistical difference was observed between the length of females carrying eyeless or eyed larvae.

5.3.2 SEASONAL VARIATION IN BROOD SIZE

5.3.2.1 Tenagomysis sp.2

Throughout the year, the percentage of mature females carrying young was high, ranging from 77.2 to 100% (Fig 5.4). The percentage of females carrying eggs, eyeless and eyed larvae varied slightly throughout the year (Table 5.8). Calculating the average percentage of the population with each type of embryo provided an estimate of the proportion of the brood-pouch life spent in each developmental stage. The mean percentages of females with each type of young were statistically different from each other when compared by t-tests. This indicates that the eyeless stage is the longest and the eyed stage the shortest in duration.

The number of young per brood of all stages of development varied seasonally (Appendix C1). A greater number was present in spring compared to autumn and winter (Fig 5.5). In every instance (except summer and autumn for eyeless larvae) measurable differences were found between the number of larvae in each season and all other seasons, as calculated by t-tests (Table 5.2). Substantially larger numbers of larvae per female were present in spring; with each successive season the number decreased and reached a low in winter.

The results of t-tests comparing the annual mean number of each stage show that the number of eggs ($\bar{x}$=8.74) was significantly different from the number of eyeless larvae ($\bar{x}$=8.11). In addition there was a significant difference between the number of eggs and eyed larvae ($\bar{x}$=9.52) and the number of eyeless and eyed larvae (Table 5.3). However, examining the means used in this test shows that the average number of eyed larvae present was greater than the average number of eggs present. Logically, this is unrealistic; there must always be as many (if not more) eggs as eyed larvae.

5.3.2.2 Anisomysis mixta australis

The percentage of mature females carrying young was generally high from October-April (69.4-83.2%) with the one exception being December, where only 14.3% of the females were carrying young (Fig 5.4). The

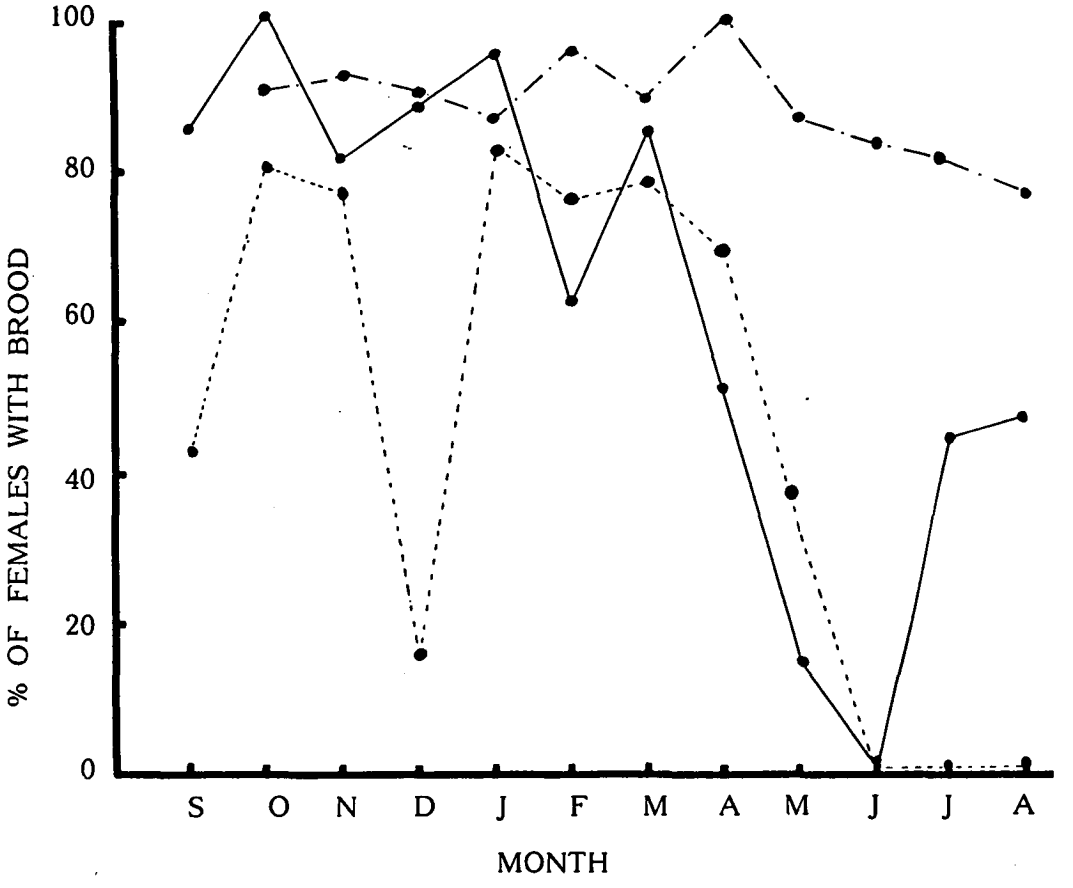


Fig. 5.4 Percentage of mature females carrying young throughout the year.

— · — · — · T.sp.2

- - - - - - - - - A.mixta australis

———— P.rufa

Table 5.8 Percentage of brooding Tenagomysis sp.2 females with each developmental stage.

MONTH	NO. OF ♀	% EGGS	% EYELESS LARVAE	% EYED LARVAE
September	-	-	-	-
October	56	41.1	55.4	3.6
November	295	39.3	35.6	25.1
December	2000	3.0	31.3	35.3
January	1795	16.7	49.6	33.7
February	490	20.4	38.8	40.8
March	392	39.5	42.1	18.4
April	34	23.5	52.9	23.5
May	1261	45.3	42.8	11.9
June	286	37.8	43.7	18.5
July	1420	35.2	47.9	16.9
August	321	23.7	54.5	21.8
$\bar{x}$		32.4	45.0	22.7
S.D.		9.6	7.9	10.8
n		11	11	11

T-test comparison of annual mean percentages:

t_{20} eggs-eyeless = 3.35
$p < 0.01$; significant difference

t_{20} eggs-eyed = 2.23
$p < 0.05$; significant difference

t_{20} eyeless-eyed = 5.53
$p < 0.001$; significant difference

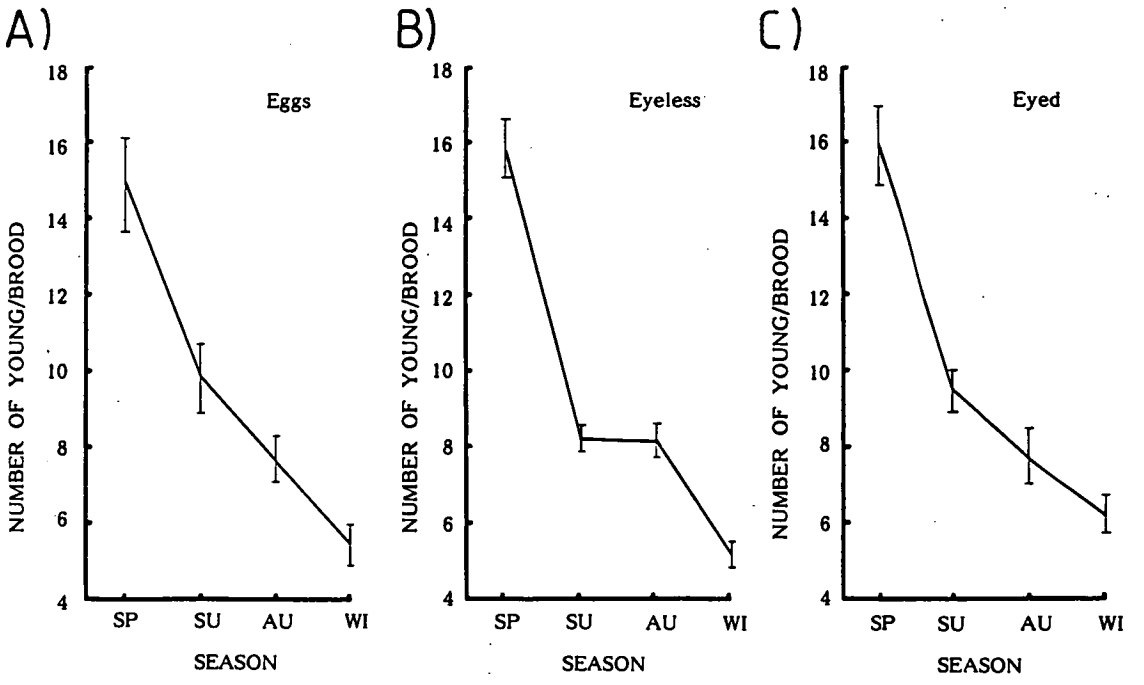


Fig. 5.5 Seasonal variation of the mean number of young present in the broods of T.sp.2.

A) Seasonal variation of the mean number (±95% confidence intervals) of young per brood for females carrying eggs.
Annual mean $\bar{x}$ = 8.74 (S.D. = 4.73; n = 258).

B) Seasonal variation of the mean number (±95% confidence intervals) of young per brood for females carrying eyeless larvae.
Annual mean $\bar{x}$ = 8.11 (S.D. = 4.08; n = 524).

C) Seasonal variation of the mean number (±95% confidence intervals) of young per brood for females carrying eyed larvae.
Annual mean $\bar{x}$ = 9.52 (S.D. = 4.24; n = 276).

anomalous figure obtained in this month is probably a result of the sub-sampling. None of the mature females present were carrying young in June-August and the percentage brooding in September (43%) and May (33.4%) was considerably lower than for the rest of the year.

The proportion of the female population carrying eggs, eyeless or eyed embryos varied during the year (Table 5.9). An average value was calculated where the total number of females was greater than n=25. The eyeless developmental stage was estimated to be the longest (accounting for 44% of brood life); significantly longer than the duration of the egg or eyed larvae (26 and 29% respectively). No difference was apparent between the length of the egg and eyed stages of development.

Variation in the number of embryos in each developmental stage was observed throughout the year (Appendix C2). Seasonal and annual means are presented in Fig. 5.6. The average number of eggs per female was significantly greater in spring than in summer or autumn (Table 5.5), but there was no perceptible difference between the number in summer and autumn. Significantly more eyeless larvae were present in spring broods than in summer, and in summer than in autumn. No clear difference between the number of eyed larvae in spring and summer was evident, but significantly more eyed larvae were present in spring compared to autumn, and in summer compared to autumn.

The annual mean number of eggs ($\bar{x}$=7.01) carried per brood showed little difference from the number of eyeless larvae ($\bar{x}$=6.4), but was significantly greater than the mean number of eyed larvae ($\bar{x}$=5.94) present per brood (Table 5.3).

5.3.2.3 Paramesopodopsis rufa

The percentage of mature females with developing broods was generally higher from September-March. However, between April and August the maximum percentage with broods was 50%, and in May only 14.3% of females were brooding young (Fig. 5.4). No mature female had young during June.

Considerable changes in the proportion of females with each type of larvae was seen throughout the year. Mean values, which were calculated only when more than 25 females were collected in each month, indicated that the eyeless stage was longer in duration than the egg and eyed stages. However, no statistical difference was present between the mean percentages of each larval stage (Table 5.10).

The number of young per brood varied throughout the year (Appendix C3). Seasonal and annual means are given in Fig. 5.7, and the

Table 5.9 Percentage of brooding Anisomysis mixta australis females with each developmental stage.

MONTH	NO. OF ♀	% EGGS	% EYELESS LARVAE	% EYED LARVAE
September	95	50.5	42.1	7.4
October	61	16.4	65.6	18.0
November	35	45.7	48.6	5.7
December	15	66.7	33.3	-
January	559	5.9	29.3	64.8
February	1338	20.4	38.9	40.7
March	246	39.4	47.2	13.4
April	1387	18.8	46.4	34.8
May	161	13.0	37.3	49.7
$\bar{x}$ (Note 1)		26.26	44.4	29.31
S.D.		16.54	10.64	21.56
n		8	8	8

Note 1: Means calculated from data only where >25 females present/month.

T-test comparison of annual mean percentages:

t_{14} eggs-eyeless = 2.61

$p < 0.05$; significant difference

t_{14} eggs-eyed = 0.32

$p > 0.7$; not significant

t_{14} eyeless-eyed = 1.78

$p > 0.05$; not significant

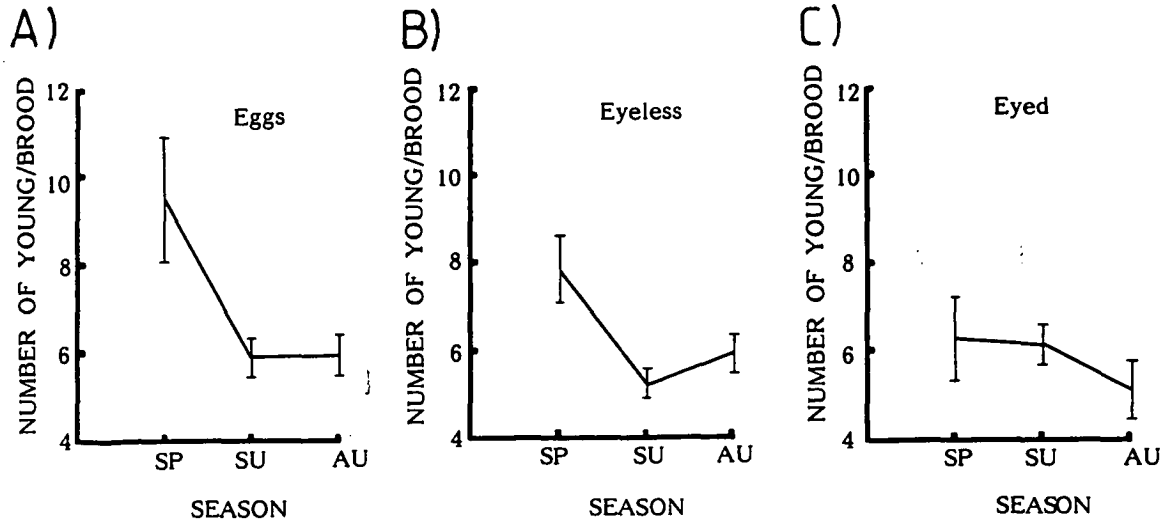


Fig. 5.6 Seasonal variation of the mean number of young present in the broods of A.mixta australis.

A) Seasonal variation of the mean number (±95% confidence intervals) of young per brood for females carrying eggs.
Annual mean $\bar{x}$ = 7.01 (S.D. = 3.09; n = 118).

B) Seasonal variation of the mean number (±95% confidence intervals) of young per brood for females carrying eyeless larvae.
Annual mean $\bar{x}$ = 6.40 (S.D. = 2.59; n = 209).

C) Seasonal variation of the mean number (±95% confidence intervals) of young per brood for females carrying eyed larvae.
Annual mean $\bar{x}$ = 5.94 (S.D. = 2.27; n = 141).

Table 5.10 Percentage of brooding Paramesopodopsis rufa females with each developmental stage.

MONTH	NO. OF ♀	% EGGS	% EYELESS LARVAE	% EYED LARVAE
September	29	17.24	65.5	17.24
October	3	66.7	33.3	-
November	96	62.5	23.96	13.54
December	450	21.11	36.7	42.2
January	307	28.01	29.97	42.01
February	25	60.0	20.0	20.0
March	45	11.11	33.33	55.56
April	10	-	100	-
May	10	-	-	100
June	0	-	-	-
July	20	75.0	25.0	-
August	20	75.0	25.0	-
$\bar{x}$ (Note 1)		27.99	37.89	34.11
S.D.		20.24	16.14	18.0
n		5	5	5

Note 1: Means calculated from data only where > 25 females present/month.

T-test comparison of annual mean percentages:

t_8 eggs-eyeless = 0.86

$p > 0.3$; not significant

t_8 eggs-eyed = 0.51

$p > 0.5$; not significant

t_8 eyeless-eyed = 0.35

$p > 0.7$; not significant

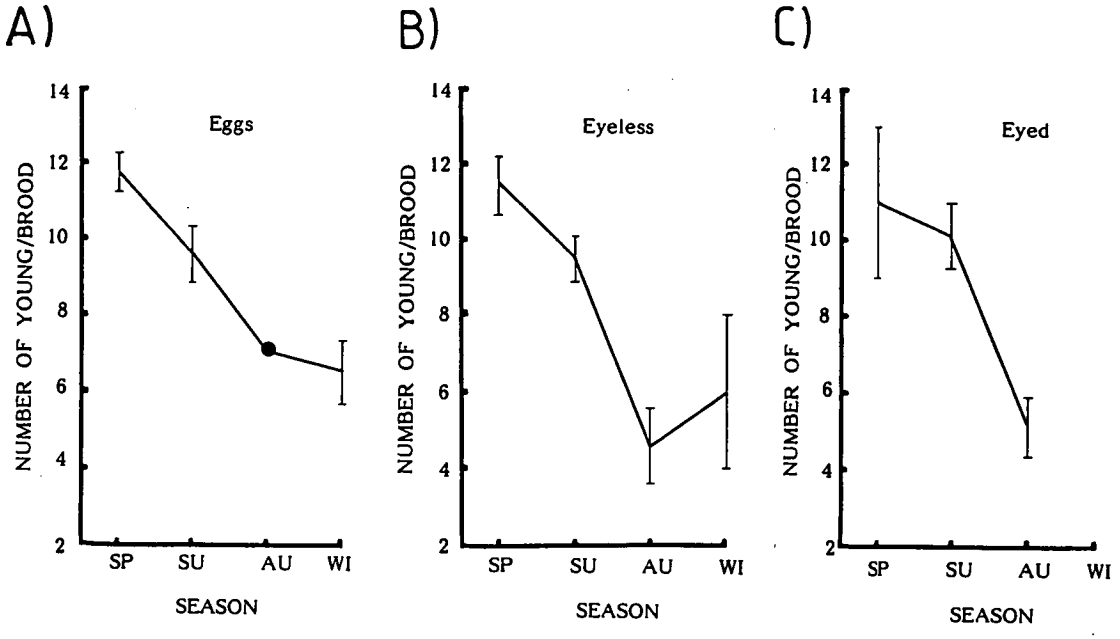


Fig. 5.7 Seasonal variation of the mean number of young present in the broods of P.rufa.

A) Seasonal variation of the mean number (±95% confidence intervals) of young per brood for females carrying eggs.
Annual mean $\bar{x}$ = 10.53 (S.D. = 2.45; n = 83). (Note that in Autumn n=1).

B) Seasonal variation of the mean number (±95% confidence intervals) of young per brood for females carrying eyeless larvae.
Annual mean $\bar{x}$ = 10.03 (S.D. = 2.90 n = 105).

C) Seasonal variation of the mean number (±95% confidence intervals) of young per brood for females carrying eyed larvae.
Annual mean $\bar{x}$ = 9.63 (S.D. = 3.30; n = 62).

results of t-tests comparing the seasonal means are provided in Table 5.7. Significantly more eggs and eyeless larvae were present in broods during spring than in any other season. In addition, more eyeless larvae were present in summer than in autumn or winter, but no real change was observed between the number of young in the broods during autumn and winter. Although there was no apparent difference between the number of eyed larvae present in spring and summer, both were significantly greater than the number in autumn broods.

There was no significant difference between the annual mean number of eggs ($\bar{x}$=10.53), eyeless ($\bar{x}$=10.03) or eyed ($\bar{x}$=9.63) larvae carried per brood (Table 5.3).

5.3.3 EGG RATIO

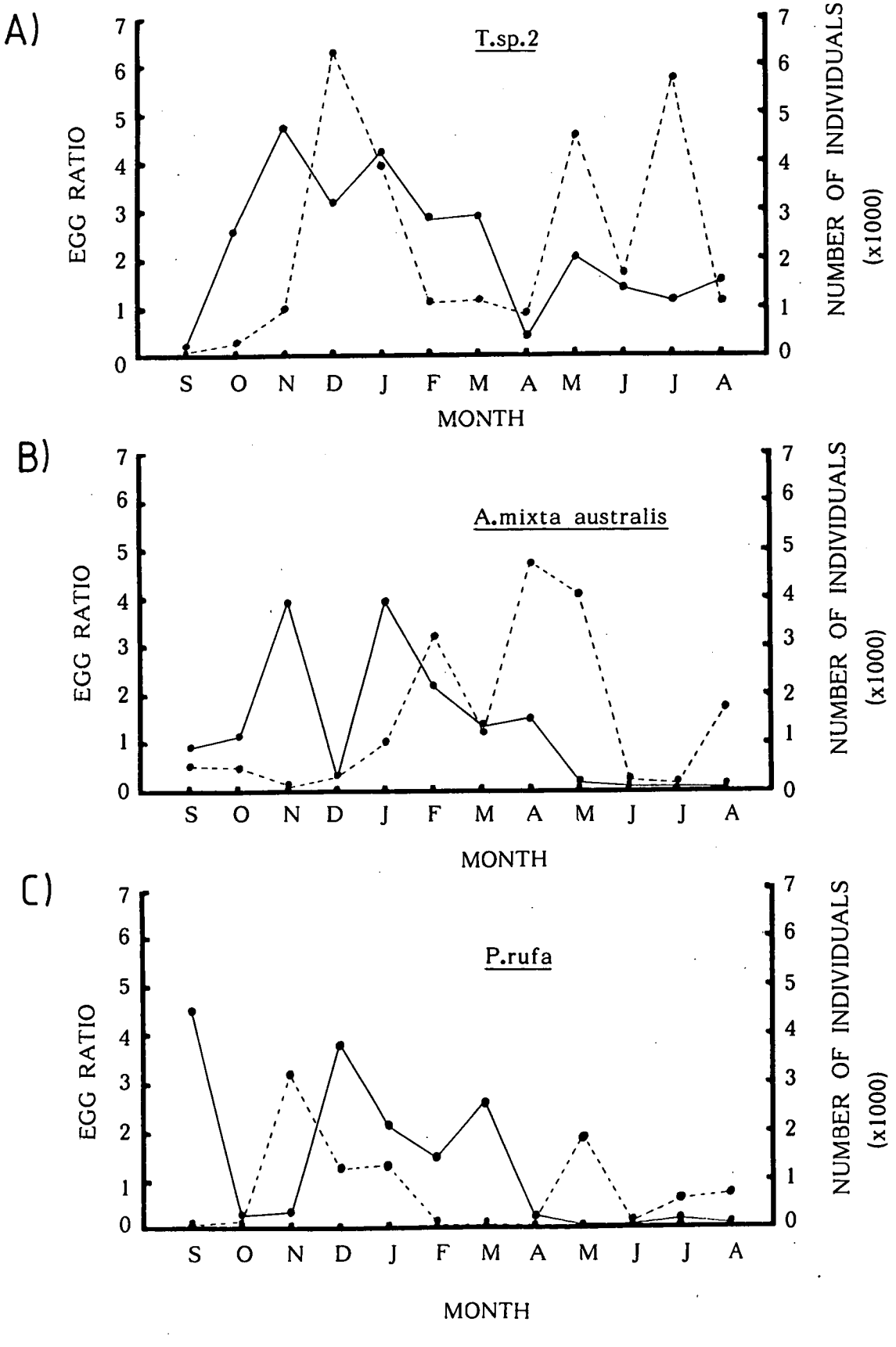
Calculation of the egg ratio for each species (Fig. 5.8) shows that the main reproductive peak for T.sp.2 occurred in spring. This spring peak was followed by the major population peak for the species in December. The reproductive rate remained high over summer as evidenced by the egg ratio, but was lower in autumn and winter. The peaks of species abundance in all cases except January were due to large numbers of juveniles in the population. In January, the population was dominated by gravid females and mature males (see Section 4.3.6.1).

For A.mixta australis, the major peak of reproduction occurred in late spring-summer with a high egg ratio in November, January and February. The low egg ratio in December was due to the large proportion of immature adults in the population (see Section 4.3.6.2), i.e. the spring generation. These individuals were mature and breeding in January, resulting in the increase in the egg ratio. This ratio declined during autumn, and was zero over the winter when reproduction ceased. During the early spring (September-October) the ratio increased. The high reproductive rate during late spring and summer was followed by the increase in total population size observed in January-May.

The egg ratio peak for P.rufa in September was followed by the major population peak in November produced by juveniles (see Section 4.3.6.3). Egg ratio was high over summer but fell almost to zero from April-August. After the highly reproductive summer months, a large number of juveniles dominated the population from April, May and June, with a species population peak in May.

5.3.4 SIZE OF LARVAE

The mean monthly sizes of each developmental stage of T.sp.2, A.mixta australis and P.rufa are plotted in Figs. 5.9, 5.10 and 5.11


A)
T.sp.2
EGG RATIO
NUMBER OF INDIVIDUALS
(x1000)
0 1 2 3 4 5 6 7
S O N D J F M A M J J A
MONTH
B)
A.mixta australis
EGG RATIO
NUMBER OF INDIVIDUALS
(x1000)
0 1 2 3 4 5 6 7
S O N D J F M A M J J A
MONTH
C)
P.rufa
EGG RATIO
NUMBER OF INDIVIDUALS
(x1000)
0 1 2 3 4 5 6 7
S O N D J F M A M J J A
MONTH

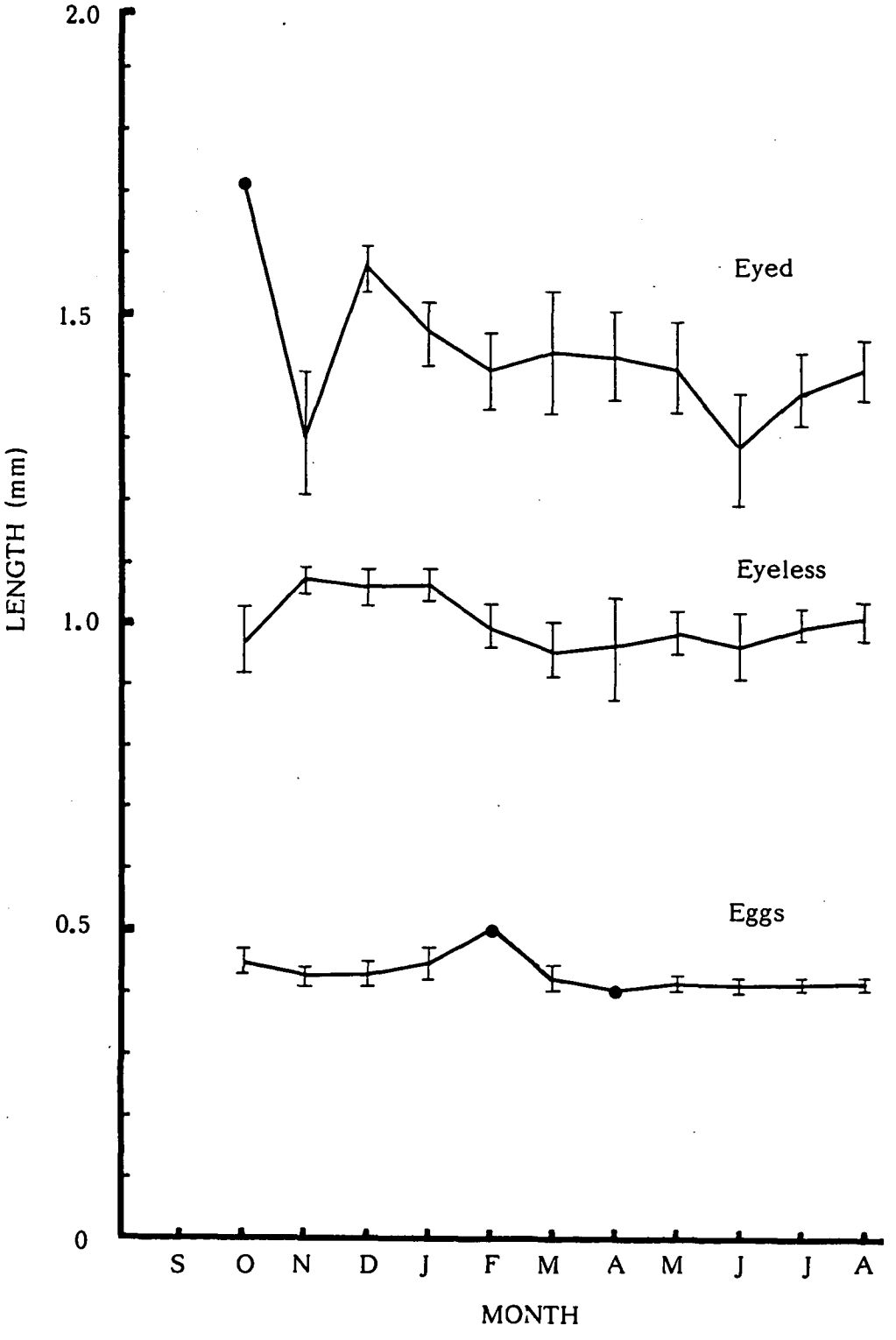


Fig. 5.9 Mean monthly size (±95% confidence intervals, where n>5) of each stage of development in the broods of Tenagomysis sp.2.

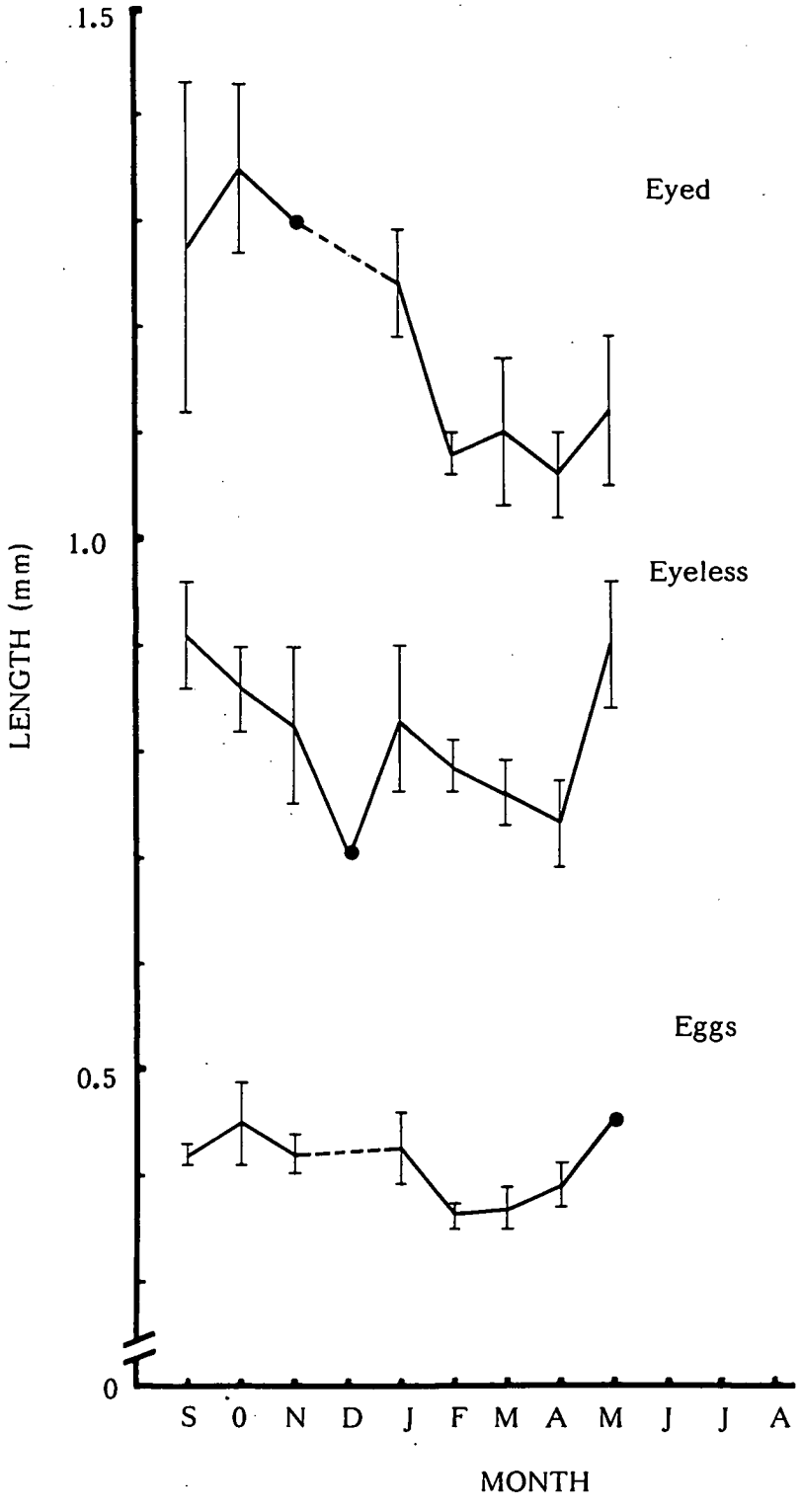


Fig. 5.10 Mean monthly size (±95% confidence intervals, where n>5) of each stage of development in the broods of Anisomysis mixta australis.

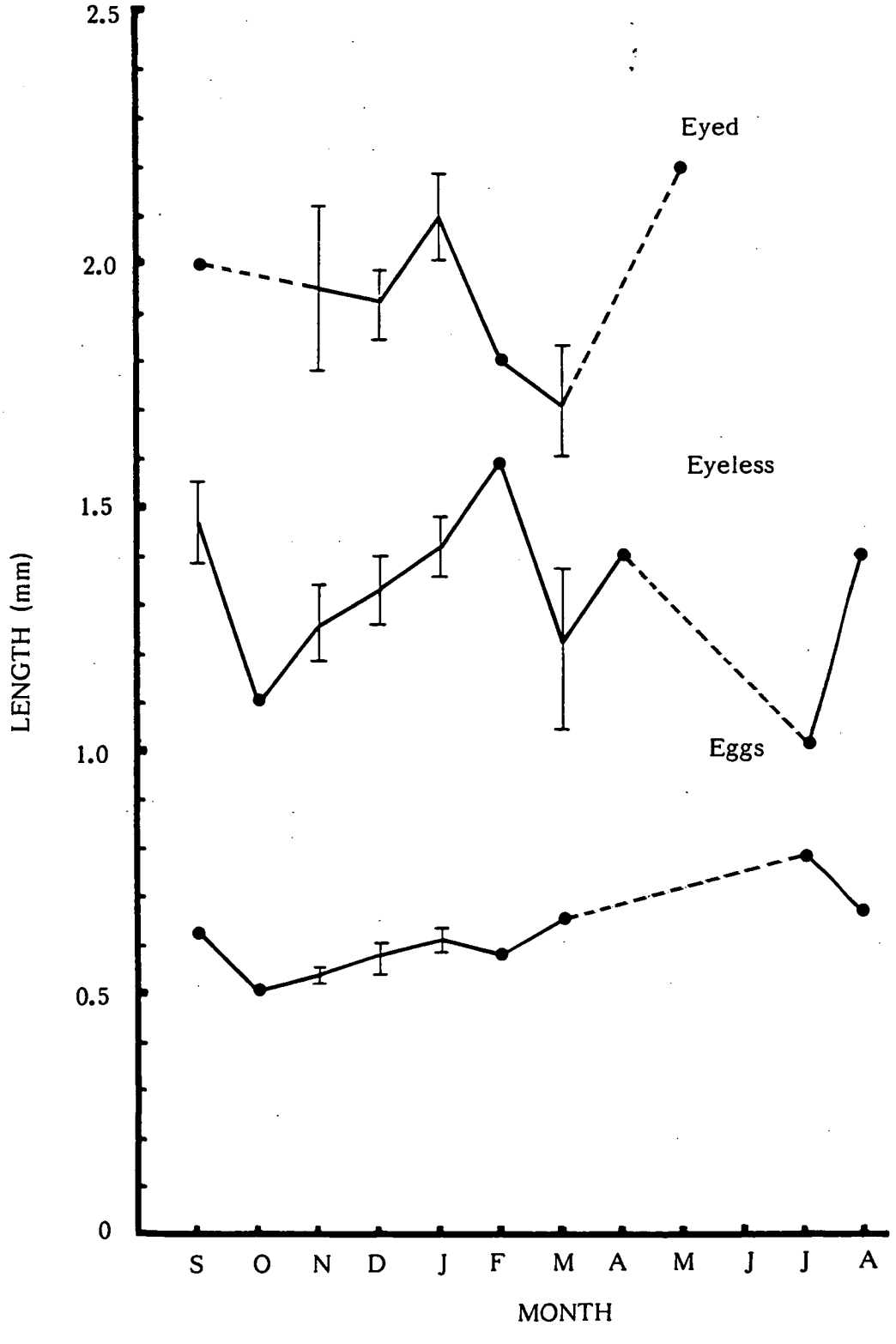


Fig. 5.11 Mean monthly size (±95% confidence intervals, where n>5) of each stage of development in the broods of Paramesopodopsis rufa.

respectively. No clear seasonal variation is evident, since considerable variation was observed in each month. The size range of each developmental phase and mean egg diameter are presented in Table 5.11.

5.3.5 LINEAR REGRESSION ANALYSIS

The results presented in 5.3.1 and 5.3.2 have shown that gravid females tended to be larger in spring. Consequently, it is necessary to examine the relationship between female length and brood size, and examine seasonal changes.

Linear regression equations were fitted to the data for each month, season and for the entire sampling period (Tables 5.12, 5.13 & 5.14). A linear relationship between female length and number of young carried in the brood pouch was evident. In all species, the larger the female, the more young were carried. A linear relationship between the number of eggs developing within the ovaries and female length was also evident (Table 5.15).

The regression coefficients were virtually identical when the number of young was plotted against female weight to those obtained for female length (Table 5.16). However, the coefficient obtained when comparing T.sp.2 females carrying eggs with female length (r=0.64) was higher than that for female weight (r=0.55). In the case of A.mixta australis the regression coefficients were slightly greater when comparing female weight than length, but the maximum improvement of the coefficient was only 0.03.

Seasonal regression equations for T.sp.2 and A.mixta australis showed that for a female of a given length more eggs were present in the broods during spring than other seasons. However, the regression for P.rufa was not significant in spring. Overall, the regression equations indicated that the number of young produced is also related to season (Table 5.17).

Furthermore, the regression equations can be used to estimate loss or mortality occurring between the successive developmental stages during brooding. Estimates of mortality vary depending on female length (Table 5.18). Mortality was lower for larger female Tenagomysis sp.2 and P.rufa, however, mortality was lower among smaller A.mixta australis females.

5.3.6 INTER-MOULT GROWTH OF FEMALES WITH BROODS

Since gravid females do not moult while carrying a brood, it is possible to estimate inter-moult growth. The growth varied seasonally and seasonal and annual means were calculated for each species (Table 5.19).

Table 5.11 Comparison of larval sizes between the three mysid species.

SPECIES	EGGS RANGE (mm)	EYELESS RANGE (mm)	EYED RANGE (mm)	EGG MEAN DIAMETER (mm)
T.sp.2	0.4-0.5	0.7-1.2	1.3-1.9	0.42
A.mixta-australis	0.3-0.4	0.6-1.0	1.0-1.5	0.39
P.rufa	0.5-0.8	1.0-1.6	1.6-2.3	0.57

Table 5.12 Linear regression equations for the relationship between female length (X) and the number of eggs developing in the brood pouch (Y) for T.sp.2, A.mixta australis and P.rufa: Seasonal and annual equations (data are plotted in Appendix C4).

SEASON	T.sp.2	A.mixta australis	P.rufa
SPRING	Y = -7.53 + 2.68X r = 0.56 n = 56 p < 0.001	Y = -9.89 + 2.72X r = 0.42 n = 36 p < 0.01	Y = 8.21 + 0.35X r = 0.13 n = 46 p < 0.39
SUMMER	Y = -8.16 + 2.29X r = 057 n = 36 p < 0.001	Y = 0.52 + 0.95X r = 0.30 n = 44 p < 0.05	Y = 0.64 + 0.89X r = 0.30 n = 30 p < 0.10
AUTUMN	Y = -10.0 + 2.40X r = 0.54 n = 74 p < 0.001	Y = 8.69 - 0.50X r = 0.15 n = 38 p < 0.39	-
WINTER	Y = -13.8 + 2.55X r = 0.40 n = 92 p < 0.001	-	-
ANNUAL	Y = -22.9 + 4.10X r = 0.64 n = 258 p < 0.001	Y = -5.09 = 2.00X r = 0.58 n = 118 p < 0.001	Y = 8.18 - 0.23X r = 0.07 n = 83 p < 0.55

Table 5.13 Linear regression equations for the relationship between female length (X) and the number of eyeless larvae developing in the brood pouch (Y) for T.sp.2, A.mixta australis and P.rufa: Seasonal and annual equations (data are plotted in Appendix C5).

SEASON	T.sp.2	A.mixta australis	P.rufa
SPRING	Y = -1.57 + 1.63X r = 0.32 n = 67 p < 0.01	Y = -16.0 + 3.38X r = 0.48 n = 76 p < 0.001	Y = 10.9 + 0.5X r = 0.02 n = 45 p < 0.92
SUMMER	Y = -5.61 + 1.74X r = 0.49 n = 179 p < 0.001	Y = 3.23 + 0.35X r = 0.13 n = 77 p < 0.26	Y = -3.63 + 1.26X r = 0.48 n = 53 p < 0.001
AUTUMN	Y = -2.74 + 1.42X r = 0.39 n = 99 p < 0.001	Y = -1.03 + 1.24X r = 0.36 n = 56 p < 0.01	-
WINTER	Y = -7.42 + 1.66X r = 0.31 n = 179 p < 0.001	-	-
ANNUAL	Y = -20.3 + 3.61X r = 0.61 n = 524 p < 0.001	Y = -3.63 + 1.61X r = 0.51 n = 209 p < 0.001	Y = -3.59 + 1.27X r = 0.41 n = 105 p < 0.001

Table 5.14 Linear regression equations for the relationship between female length (X) and the number of eyed larvae developing in the brood pouch (Y) for T.sp.2, A.mixta australis and P.rufa: Seasonal and annual equations (data are plotted in Appendix C6).

SEASON	T.sp.2	A.mixta australis	P.rufa
SPRING	Y = -9.20 + 2.80X r = 0.32 n = 40 p < 0.05	Y = 1.62 + 0.64X r = 0.12 n = 16 p < 0.67	Y = 2.61 + 0.72X r = 0.23 n = 11 p < 0.50
SUMMER	Y = -9.89 + 2.34X r = 0.45 n = 147 p < 0.001	Y = -4.84 + 1.79X r = 0.55 n = 99 p < 0.001	Y = -15.8 + 2.41X r = 0.68 n = 43 p < 0.001
AUTUMN	Y = -15.58 + 3.02X r = 0.69 n = 28 p < 0.001	Y = 9.18 - 0.73X r = 0.15 n = 39 p < 0.03	-
WINTER	Y = -3.41 + 1.25X r = 0.24 n = 61 p < 0.07	-	-
ANNUAL	Y = -22.8 + 3.94X r = 0.64 n = 276 p < 0.001	Y = -2.11 + 1.31X r = 0.45 n = 141 p < 0.001	Y = -13.7 + 2.16X r = 0.62 n = 62 p < 0.001

Table 5.15 Linear regression equations for the relationship between female length (X), as expressed in mm, and number of young developing in the ovaries (Y) for T.sp.2, A.mixta australis and P.rufa: Annual data (data are plotted in Appendix C7).

T.sp.2	A.mixta australis	P.rufa
Y = -12.8 + 3.32X r = 0.53 n = 50 p < 0.001	Y = -6.09 + 2.89X r = 0.75 n = 23 p < 0.001	Y = -4.78 + 1.73X r = 0.64 n = 24 p < 0.001

Table 5.16 Linear regression equations for the relationship between female weight (W), as expressed in mg units, and number of young developing in the brood pouch (Y) for T.sp.2, A.mixta australis and P.rufa: Annual data (data are plotted in Appendix C8).

DEVELOPMENTAL STAGE	T.sp.2	A.mixta australis	P.rufa
EGGS	Y = 3.19 + 9.18W r = 0.55 n = 258 p < 0.001	Y = 3.05 + 7.42W r = 0.60 n = 118 p < 0.001	Y = 8.67 + 1.05W r = 0.07 n = 83 p < 0.55
EYELESS LARVAE	Y = -3.23 + 8.35W r = 0.62 n = 524 p < 0.001	Y = 2.87 + 6.17W r = 0.54 n = 209 p < 0.001	Y = -0.92 + 5.85W r = 0.41 n = 105 p < 0.001
EYED LARVAE	Y = -3.49 + 8.65W r = 0.64 n = 276 p < 0.001	Y = 3.23 + 4.90W r = 0.46 n = 141 p < 0.001	Y = -8.96 + 9.80W r = 0.62 n = 62 p < 0.001

Table 5.17 Seasonal variation of the number of eggs present in the brood derived by regression analysis.

SPECIES	♀ LENGTH (mm)	SPRING	SUMMER	AUTUMN	WINTER
T.sp.2	7.0	11.23	7.87	6.76	4.06
A.mixta australis	6.0	6.42	6.22	5.70	0
P.rufa	10.0	11.66	9.47	*	*

* = number of results too low to derive a regression equation.

Table 5.18 Estimation of brood mortality using annual values derived from regression equations in Tables 5.12, 5.13 & 5.14.

SPECIES	FEMALE LENGTH (mm)	NUMBER OF EGGS	NUMBER OF EYELESS	NUMBER OF EYED	% BROOD MORTALITY
T.sp.2	7.0	5.80	4.98	4.70	17.70
	8.0	9.90	8.59	8.71	11.95
	9.0	13.99	12.81	12.62	9.79
A.mixta australis	5.5	5.92	5.23	5.09	14.0
	6.5	7.92	6.84	6.39	19.3
	7.5	9.92	8.45	7.70	22.4
P.rufa	9.0	10.24*	7.84	5.71	44.2
	10.0	10.47*	9.11	7.86	24.93
	11.0	10.70*	10.38	10.02	6.40

* Poor regression coefficients for this equation.

Table 5.19 Estimation of inter-moult growth of brooding females.

SPECIES & STUDY PERIOD	MEAN FEMALE LENGTH (mm) EGGS	EYELESS	EYED	INTER-MOULT GROWTH (mm)	GROWTH AS % OF LENGTH
T.sp.2					
SP $\bar{x}$	8.36	8.76	8.98	0.62	7.4
SU $\bar{x}$	7.85	7.94	8.29	0.44	5.6
AU $\bar{x}$	7.40	7.66	7.73	0.33	4.5
WI $\bar{x}$	7.54	7.57	7.71	0.17	2.3
TOTAL $\bar{x}$	7.72	7.87	8.20	0.48	6.2
A.mixta australis					
SP $\bar{x}$	7.13	7.07	7.26	0.13	1.8
SU $\bar{x}$	5.64	5.80	6.11	0.47	8.3
AU $\bar{x}$	5.49	5.63	5.64	0.15	2.7
TOTAL $\bar{x}$	6.05	6.22	6.16	0.11	1.8
P.rufa					
SP $\bar{x}$	10.25	11.15	11.70	1.45	14.20
SU $\bar{x}$	10.15	10.44	10.77	0.62	6.11
AU $\bar{x}$	10.50	9.82	9.90	- *	
WI $\bar{x}$	10.90	10.35	-	- *	
TOTAL $\bar{x}$	10.26	10.71	10.82	0.56	5.50

* Low value of n contributed to the mean in this season; these value of inter-moult growth are negative and thus invalid.

Inter-moult growth was greater during spring for T.sp.2 and P.rufa, but greater during summer for A.mixta australis. The inter-moult growth was estimated as 6.2% body length for T.sp.2, 5.5% for P.rufa and 1.8% for A.mixta australis over the entire year.

5.3.7 ESTIMATION OF INCUBATION TIME

The unifying model proposed by Wittmann (1984) has been applied to the data for each species in an attempt to provide an estimate of the duration of brood pouch life (Table 5.20). From the average estimate of brood duration and the average percentage of females with broods of each developmental stage (Table 5.8, 5.9 & 5.10), a rough estimate of the length of each developmental stage can be obtained (Table 5.21).

Brood duration is shorter during the summer months. Considering the seasonal relationship between the number of young produced in spring and summer, natality appears to be highest during the late spring, summer and early autumn for all species (Table 5.22). The mean brood duration over the entire sampling period was estimated to be 21.89 (±2.1 days) for T.sp.2, 17.79 (±2.1 days) for A.mixta australis and 25.86 (±2.2 days) for P.rufa.

The applicability to the Tasmanian mysids of the model of Wittmann (1984) for estimating the incubation period based on egg diameter and temperature clearly requires testing by laboratory experiments.

5.4 DISCUSSION

Breeding was continuous in all three species from spring till the end of autumn with each female producing more than one brood (since eggs were present in the ovaries of females carrying young). Consequently, their populations consisted of mixed age groups which obscured individual generations. However, breeding was most intensive during spring and summer. Winter breeding was present among T.sp.2 and P.rufa females only, but a clear winter depression in the breeding cycle was evident (discussed in 4.4). As a result of the winter depression, the production of a spring generation was easily identifiable (4.3). This generation matured during spring, producing a summer generation. Breeding females from the over-wintering population died off at this time. This was evident in the population since large gravid females, which occurred in spring and summer, disappeared from the population during the summer. Males also followed this pattern (4.3.6). Females and males (4.3.6) matured and bred at a smaller size during late spring, summer and autumn. The members of the spring generation probably produce two or more broods. Members of the summer generation may produce young during autumn, although most form part of the

Table 5.20 Estimated brood duration.

MONTH	T.sp.2 BROOD LENGTH (DAYS)	T.sp.2 NO. OF BROODS/ MONTH	A.mixta australis BROOD LENGTH (DAYS)	A.mixta australis NO. OF BROODS/ MONTH	P.rufa BROOD LENGTH (DAYS)	P.rufa NO. OF BROODS/ MONTH
September	-	-	26.24	1.14	35.48	0.85
October	26.04	1.19	24.55	1.26	33.20	0.93
November	20.25	1.48	19.09	1.57	25.81	1.16
December	18.37	1.69	17.32	1.79	23.42	1.32
January	15.15	2.05	14.28	2.17	19.31	1.61
February	13.91	2.01	13.12	2.13	17.73	1.58
March	15.47	2.00	14.59	2.13	19.72	1.57
April	20.25	1.48	19.09	1.57	25.81	1.16
May	23.33	1.33	22.00	1.41	29.74	1.04
June	26.04	1.15	-	-	-	-
July	31.10	1.00	-	-	39.65	0.78
August	30.93	1.00	-	-	39.43	0.79
YEARLY VALUES	$\bar{x}$=21.89 ±2.1	16.38 BROODS/YR	$\bar{x}$=17.79 ±2.1	15.18 BROODS/YR	$\bar{x}$=25.86 ±2.2	12.79 BROODS/YR

Table 5.21 Duration of each development stage, during brood life.

SPECIES	DURATION OF DEVELOPMENTAL STAGE IN DAYS EGGS	EYELESS	EYED
T.sp.2	7.09	9.84	4.97
A.mixta australis	4.67	7.90	5.21
P.rufa	7.24	9.80	8.82

Table 5.22 Estimation of natality in each month. Natality is expressed as the number of eyed larvae derived from seasonal regression equations in Table 5.14.#

MONTH	SPECIES		
	T.sp.2	A.mixta australis	P.rufa
September	-	0.21	0.28
October	0.51	0.22	0.30
November	0.65	0.29	0.38
December	0.48	0.34	0.35
January	0.58	0.41	0.43
February	0.64	0.45	0.47
March	0.56	0.33	*
April	0.42	0.25	*
May	0.37	0.22	*
June	0.25	-	*
July	0.21	-	*
August	0.21	-	*

Regression equations were derived for female T.sp.2, A.mixta australis and P.rufa of 8, 6 and 10mm in length, respectively.

* Number of results too low to derive a regression equation between female length and number of eggs per brood.

over-wintering generation. This basic pattern appears to be very similar to that observed for the majority of temperate coastal mysid species (Mauchline, 1980; Wittmann, 1984). In addition, both fecundity and natality underwent seasonal variation, with fecundity highest during spring in all three species, and natality was estimated to be greatest during late spring summer and early autumn. Such strong seasonal variations of reproduction are well known among temperate mysid species and thought to be mainly in response to changes in food supply (Mauchline, 1980; Wittmann, 1981b, 1984).

The seasonal variation of female length and brood size observed in the three species examined here is typical of the majority of iteroparous species in temperate climates (Wittmann, 1984). Although in some temperate species larger eggs are produced in winter compared to those during summer (Mauchline, 1973b); however, this trend was not observed here. In virtually all the mysid species examined to date, brood size has been shown to increase with increasing female body size (Mauchline, 1980; Wittmann, 1984). Interestingly, there is also some evidence to suggest after a certain length is reached, the brood size decreases. Yan (1982) found that the brood size decreased for female Neomysis awatschensis beyond 13.5mm in length. In the three species examined here, the number of young was linearly related to female length. The regression coefficients were not above 0.65 for any species. The coefficients, although low, are not unreasonable, since Mauchline (1980) noted that although numerous species exhibit a relationship between the number of young and female body length, it is difficult to demonstrate for mysid species smaller than 10mm in length and with brood sizes of less than fifteen. Wittmann (1984) suggested that the number of young in the brood was more closely related to female weight than length. However, regressions for the three species using female weight did not improve the linear relationship (as indicated by the regression coefficient).

Mortalities of young has been shown to occur during brood pouch development for many mysid species (Mauchline, 1973b & 1980). Generally, mortality is about 10% ranging from 0-20% (Mauchline, 1973b). Similar percentages were obtained for T.sp.2, A.mixta australis and P.rufa, although the results were generally above 10%. Mortality in the brood pouch appeared to vary with female length. Greater mortality occurred in larger females for A.mixta australis, but for T.sp.2 and P.rufa it was lower for larger females. Varying levels of brood mortality for females of different lengths have also been observed for the surf-zone South African species Gastrosaccus psammodytes (Wooldridge, 1981); mortality of young was greater

for larger females (eg. 9% for 12mm, 25% for 18mm). The reasons for different levels of mortality for females of different lengths would be worth examining further. However, the level of mortality estimated using regression equations must be a function of the accuracy of these equations.

Most premature losses from the brood pouch presumably result in mortality; however Wittmann (1978) and Mauchline (1980) have shown that some of the young lost can be caught by females (not always of the same species) and placed in their own brood pouch. Interestingly, these adopted larvae are generally older than the larvae of the female's own brood, and are ready for release prior to her own brood. If younger larvae were adopted their chances of survival would be reduced, since they would be released prematurely with the female's own brood (Mauchline, 1980).

While females are carrying a brood, they do not moult, but they do increase in size. Inter-moult growth is, according to Mauchline (1973a), achieved by stretching of the abdominal joints. Mauchline (1973a) examined inter-moult in thirteen species; the average increase in body length was 7% and ranged between 3-10%. Among the species under current investigation, only A.mixta australis fell outside this range with an estimate of only 1.8%.

Females with empty brood pouches were nearly always present in the samples, but usually in low numbers during the main breeding season. Reasons for the presence of females with empty brood pouches include abortion or inter-moult periods which are longer than the incubation period for the brood (Wittmann, 1984). However, a substantial number of females with empty brood pouches are probably purely the result of collection, preservation and sub-sampling procedures (Mauchline, 1980; Wittmann, 1984). Toda et al. (1982) suggested the use of formalin containing 50g/l sucrose [recommended by Haney and Hall (1973) for Daphnia] to reduce losses from brood pouches during sampling handling.

5.5 SUMMARY

1. The number, size and developmental stage of young present in the brood pouch of female T.sp.2, A.mixta australis and P.rufa was recorded throughout the year.

2. Breeding was intensive from spring till the end of autumn for the three species. Calculation of the egg ratio for each species showed that their major reproductive peaks occurred during spring and summer. A winter depression in the breeding cycle was observed for T.sp.2 and P.rufa, but A.mixta australis ceased breeding during winter.

3. Seasonal variation in the length of gravid females and the number of young carried was evident for these three species, i.e. generally longer females occurred during spring and summer and also more young were carried in these seasons than in autumn and winter.

4. No seasonal variation in the size of eggs was evident for the three species.

5. A linear relationship between female length and brood size was demonstrated for each species; annual and seasonal equations were calculated for females carrying each developmental stage. The seasonal equations showed that for a female of given length fecundity was greater during spring than any other season.

6. Seasonal variation of natality for the three species was indicated i.e. natality was estimated to be highest during late spring, summer and early autumn.

7. The reproduction pattern of T.sp.2, A.mixta australis and P.rufa appears to be very similar to that reported for the majority of iteroparous coastal temperate mysids throughout the world.

CHAPTER 6

PRODUCTION AND BIOMASS

6.1 INTRODUCTION

Despite many studies of population dynamics of mysid species, relatively few estimates of mysid production rates have been published. This is somewhat surprising because the importance of mysids in many marine and freshwater communities is well documented (Mauchline, 1980). Apart from the importance of mysids in the diet of numerous commercially exploited fish species (Tattersall and Tattersall, 1951; Mauchline, 1980), mysids are being used as live food in fish-farms, particularly for freshwater fisheries. For example, Mysis relicta has been introduced into lakes in Sweden, Canada and the United States (Mauchline, 1980), and mysids themselves have been commercially exploited (Tattersall and Tattersall, 1951); in Japan between 1000 and 10000 tons of Neomysis intermedia, N.japonica and Acanthomysis mitsukurii are harvested annually (Omori, 1978).

Results from previous chapters had shown that reproduction was relatively continuous throughout the year for Tenagomysis sp.2, Anisomysis mixta australis and Paramesopodopsis rufa. Consequently it was necessary to calculate production by using a method which did not require the identification and tracking of cohorts. Two methods, firstly the size frequency method (Waters and Hokenstrom, 1980; Hynes, 1980) and secondly, the method developed by Petrovich et al. (1964) and later modified by Winberg (1971) are both applicable for the calculation of mysid production. The size frequency method is used to calculate production by summing the biomass lost between successive size classes (Menzie, 1980) and the method of Petrovich et al. (1964) calculates production by summing the product of the growth rate of each size class and the mean density. Both methods of calculating production have been applied to mysids with extended periods of reproduction (Bremer and Vijverberg, 1982; Sell, 1982).

In order to calculate production, the growth rate of the species at all stages of development are required. Mysids, as with all crustaceans, moult. Although there is some increase in body size achieved by stretching of the integument between moults, the main increase in size occurs at successive moults (Mauchline, 1973a; Mauchline, 1976). Growth rates, calculated from detailed laboratory experiments, have been reported for only a few species e.g. Metamysidopsis elongata (Clutter and Theilacker, 1971),

Leptomysis lingvura and Hemimysis speluncola (Gaudy and Guerin, 1979) and recently Neomysis integer (Astthorsson and Ralph, 1984). However, it is frequently possible to estimate and construct growth curves from field population studies (Lasenby and Langford, 1972; Childress and Price, 1978; Bremer and Vijverberg, 1982).

Secondary production estimates were calculated for T.sp.2, A.mixta australis and P.rufa in the present study using both the size frequency method (Menzie, 1980) and the method of Petrovich et al. (1964) modified by Winberg (1971). Growth rates were determined from field data, after laboratory experiments proved unsuccessful. The annual turnover rate (P:B), which is a measure of the number of times the standing crop is renewed in a year, is reported for each species, and compared with values known for other mysid species.

6.2 MATERIALS AND METHODS

6.2.1 LENGTH-WEIGHT RELATIONSHIP

The relationship between total length of freshly collected mysids and their dry weight was determined for each species. Dry weight was determined by drying individuals for at least 18h at 55-60°C, and subsequent weighing accurate to the nearest µg.

6.2.2 GROWTH RATE

6.2.2.1 Laboratory Procedure

Juveniles (n=15), immature adults (n=15) and mature adults (n=10) of each species were placed singly in beakers in a tray of recirculating filtered seawater at 10 and 15°C; i.e. approximately winter and summer water temperatures experienced at the study site (4.3.1). Several different diets were tried, including freshly hatched Artemia sp. (1-3 day old), dried zooplankton collected at One Tree Point, and dried or fresh detrital algae also collected at the study site. In every instance, a surplus of food was supplied, and the beakers were cleaned every second day after first transferring the mysid to a clean beaker by pipette. The beakers were checked daily for moults, deaths and release of young from brooding females. Survival was a serious problem. Although moults were collected from a few individuals, none successfully moulted a second time.

The reasons for poor survival during the growth experiments are not clear, since it was relatively easy to maintain populations of these three species of mysids in the laboratory in a large aquarium (1m x 0.5m x 0.5m)

using the system described by Reitsema and Neff (1980). However, survival was reduced when individuals were isolated from each other in the growth chambers. Moults were only very rarely observed in the large aquarium; probably the moults were consumed by the other individuals present after ecydysis.

6.2.2.2 Estimation of Growth Rates from Field Data

Larval growth rate was estimated from the mean time of brood duration (5.3.7). The growth rate of juveniles was assumed to be the same as that estimated for larval stages. For immature and mature adults, the growth rate was estimated from the field data by calculating the mean monthly increase in length of individuals throughout the year (Bremer and Vijverberg, 1982).

6.2.3 CALCULATION OF PRODUCTION

6.2.3.1 Size Frequency Method

Annual production was calculated by estimating the number of individuals growing into each size class (N_j) and calculating the losses occurring between successive size classes (N_j-N_{j+1}). These losses are converted to losses in biomass as an estimate of production:

$$N_j = i\ \bar{n}_j\ (e_j/a_j)(1/CPI) \qquad (1)$$

where i = number of size classes

$\bar{n}_j$ = mean annual density of size class j (expressed in number m^{-3})

$e_j = 1/i$

a_j = the proportion of the life-span spent in size class j

CPI = life-span (yr) from release as an egg to death in the largest size class

Substituting 1/i for e_j in equation (1), the equation can be rewritten as:

$$N_j = \bar{n}_j/D_j \qquad (2)$$

where $D_j = a_j$ CPI, which is the developmental time (yr) spent in size class j. An average value of CPI was used here as suggested by Menzie (1980), based on the average growth rates determined from field data.

Production is then calculated:

$$P = \sum_{j=1}^{i} (N_j - N_{j+1}) \; (W_j \; W_{j+1})^{1/2} \qquad (3)$$

where W_j = the mean weight of an individual in size class j.

To estimate the weight of individuals lost, the geometric mean of the mean size class weights, $(W_j \; W_{j+1})^{1/2}$ is used as suggested by Krueger and Martin (1980).

6.2.3.2 Petrovich Method

Production is calculated by the equation formulated by Petrovich et al. (1964), in Winberg (1971):

$$P = \sum_{i+1}^{s} \left(\frac{W_{i+1} - W_i}{D_i} \times \bar{N}_i \right)$$

where P = daily production

W_i = initial weight of the size class

D_i = development time in days

$\bar{N}_i$ = mean density $m^{-3}d^{-1}$ calculated for the entire sampling period

and s = total number of size classes.

6.3 RESULTS

6.3.1 LENGTH-WEIGHT RELATIONSHIPS

The relationship between total length (L) and dry weight (W) is given by the regression equation for:

a) Tenagomysis sp.2

$W = 0.008537 \; L^{2.4511}$ $\quad (r^2 = 0.91; \; n = 60)$

b) Anisomysis mixta australis

$W = 0.00227 \; L^{2.998}$ $\quad (r^2 = 0.95; \; n = 54)$

c) Paramesopodopsis rufa

$W = 0.0988 \; L^{1.2402}$ $\quad (r^2 = 0.89; \; n = 54)$

6.3.2 ESTIMATION OF MEAN GROWTH RATE

a) Tenagomysis sp.2

Larval and juvenile (size classes 1-5) growth rate was estimated as 2.15mm month^{-1}. For the remaining size classes, growth was estimated at 0.85mm month^{-1}. The mean life span from egg to death in the largest size class (10-10.9mm) was estimated as 9.39 months or 0.78 yr.

b) Anisomysis mixta australis

Larval and juvenile growth rate (assumed to apply for the first 3 size classes since immature adults were present in size classes beyond these) was estimated as 2.02mm month^{-1}. The growth rate for all other size classes was estimated as 0.97mm month^{-1}. Consequently, the mean life span was estimated to be 7.68 months of 0.64 yr.

c) Paramesopodopsis rufa

The larval and juvenile growth rate of 2.02mm month^{-1} was applied to the first five size classes; i.e. up to 4.9mm in length. Beyond this size class, the rate was estimated to be 1.87mm month^{-1}. Estimation of the mean life span was 7.29 months or 0.61 yr.

6.3.3 PRODUCTION ESTIMATES

The production results for all species and using both methods are presented in Table 6.1 and the calculations are given in Appendix D. There is close agreement between the results using both methods. Tenagomysis sp.2 has the greatest rate of production, followed by P.rufa and A.mixta australis. However, calculation of the turnover ratio P:B shows A.mixta australis has a higher value than either of T.sp.2 or P.rufa. The values for the latter two species are very similar to each other.

6.4 DISCUSSION

The P:B ratios calculated by both methods were virtually identical. The size frequency (Hynes) method in its present form incorporating the modifications of Hamilton (1969) and Benke (1979) has considerably increased the accuracy of the method (Krueger and Martin, 1980; Menzie, 1980). In recent years it has become widely accepted (Cushman et al., 1978; Benke, 1979; Waters, 1979; Dessaix and Roux, 1980; Waters and Hokenstrom, 1980). Both Hamilton (1969) and Benke and Waide (1977) have shown that if a linear growth model is used, large errors are not produced. Of course, if growth data for each size class is available, production estimates are more

Table 6.1 Annual estimates of production (P), biomass (B) and annual turnover ratio (P:B) for T.sp.2, A.mixta australis and P.rufa.
A) Size frequency method.
B) Petrovich method.

SPECIES	P (mg m^{-3} yr^{-1})	B (mg m^{-3})	P:B (yr^{-1})
A) Size frequency method			
T.sp.2	71.76	13.39	5.36
A.mixta australis	20.73	2.75	7.54
P.rufa	28.49	5.25	5.43
B) Petrovich method			
T.sp.2	79.57	14.52	5.49
A.mixta australis	23.07	2.98	7.73
P.rufa	30.30	5.69	5.33

accurate (Menzie, 1980).

The production estimates calculated here are probably underestimates because the smaller size classes, containing recently released juveniles in the 2.0-2.99 and 3.0-3.99mm size classes, and probably the smaller members of the 4.0-4.99mm class, are not sampled accurately. The mesh size of the net ($1mm^2$) allows the smaller individuals to escape. In addition, production of exuviae was not included. Production of exuviae by euphausiids has been shown to make an important contribution to the environment; this does not seem to have been estimated in mysid production calculations to date, although Clutter and Theilacker (1971) estimated the energy lost by moulting for a population of Metamysidopsis elongata to be between 6.3 and 10.4%. Ritz and Hosie (1982) estimated that the annual production of exuviae for the euphausiid Nyctiphanes australis in Storm Bay in Tasmania was 41.026mg m^{-3} yr^{-1}. Together with the annual production for the species 78.293mg m^{-3} yr^{-1} this gave a P:B estimate of 22.1, compared to their value of 13.3-14.5 estimated for N.australis without including the production and biomass contributions of exuviae. Since moults were rarely obtained from the Tasmanian mysids, it was not possible to estimate the contribution of mysid exuviae to the production and biomass of the species. But clearly, this is worth investigating in the future.

The average growth rates estimated in the present study are comparable with but lower than those reported in several other studies. Monthly growth rates for immature and mature Neomysis integer in the Ythan estuary, Scotland, were estimated to be about 4-5mm $month^{-1}$ and 1-2mm $month^{-1}$ respectively in summer, whereas in winter values of 3-4mm $month^{-1}$ and 1-2mm $month^{-1}$ were obtained (Ralph and Astthorsson, 1984). Bremer and Vijverberg (1982) reported higher growth rates during the summer for the same species in the Netherlands; the juvenile rate was the same (4-5mm $month^{-1}$), but the adult rate was 2-3mm $month^{-1}$. Dadswell (1975) reported a growth rate of about 3mm $month^{-1}$ for juvenile Mysis gaspensis in Newfoundland, Canada.

Although only estimates of growth rate were available and assumptions were made in applying them to the population, the estimation of production has produced realistic results comparable to those found for other mysid species (Table 6.2). In fact, the turnover rate of these Tasmanian mysids is among the highest values reported. Consequently, the high P:B ratios for these mysids indicates that they are of prime importance in the energy flow of this sub-littoral community.

Table 6.2 Examples of annual turnover ratios (P:B) for other mysid species.

SPECIES	LOCALITY	P:B (yr^{-1})	AUTHOR
Paramysis intermedia (FW)	Tsimlyanskoye Reservoir, (USSR)	0.91-2.25 (monthly)	Miroshnichenko & Vovk (1973)
Mysis relicta (FW)	Lake Paajarvi, Finland	3.0-8.0	Hakala (1978)
Neomysis integer (FW)	Frisian Lake, Netherlands	4	Bremer & Vijverberg (1982)
Mysis relicta (FW)	Five Great Lake populations	2.2-3.3	Sell (1982)
Neomysis mirabilis	Sea of Japan	0.13-0.17	Shushkina (1973)
Neomysis americana	Long Island sound	3.66	Richards & Riley (1963)
Rhopalophthalmus terrantalis	South Africa estuarine species	8.66	Wooldridge (1983)
T.sp.2	One Tree Pt.	5.36(S-F) 5.49(P)	Present Study
A.mixta australis	" "	7.54(S-F) 7.73(P)	" "
P.rufa	" "	5.43(S-F) 5.33(P)	" "

Note: FW denotes fresh-water species.
(S-F) = Size-Frequency method.
(P) = Petrovich method.

6.5 SUMMARY

1. Annual production estimates were calculated for T.sp.2, A.mixta australis and P.rufa using the size-frequency and Petrovich methods.

2. The annual production was higher for T.sp.2 than P.rufa and A.mixta australis.

3. The P:B ratio was however, higher for A.mixta australis than T.sp.2 and P.rufa.

4. The P:B values for the three species are among the highest ratios reported for mysids.

CHAPTER 7

DIET AND PREDATORS

7.1 INTRODUCTION

Gaining an understanding of the trophic relationships of the mysids at the study site is essential for the proper interpretation of the role of these mysids in this inshore coastal community. The diets of the mysid species themselves and their predators in the community need to be identified. This has been tackled in two ways during the present study. Firstly, by stomach contents analysis of the mysids and a range of potential predators collected at the study site, and secondly, by employing a food web tracing technique.

Mysids have long been described as having two distinct methods of feeding (Cannon and Manton, 1927). The first is by feeding on large food masses, which is essentially a raptorial process in which prey is actively captured by the thoracic appendages, and the second is by filter-feeding the suspended particulate organic matter present in the water column. Recently, Attramadal (1981) examined the filtration mechanism of Hemimysis lamornae and Praunus flexuosus, and found that no ventral filtration current existed. The earlier finding of Cannon and Manton (1927), who described a forwardly directed ventral filtration current, appears to have been an artifact of the water level used in their experiment. Thus, the process of feeding by filtering a self generated current appears to be non-existent, but Attramadal (1981) observed that the species he investigated collected and ate small particles which adhered to their setae and body surface by various cleaning movements. Despite the present ambiguity as to the process of feeding, the stomach contents of many mysid species have been reported in the literature. Most of the species which have been examined appear to be omnivorous, consuming a wide range of prey items including algae, diatoms, dinoflagellates, copepods, other crustacea, terrigenous material and detritus (Bowers and Grossnickle, 1978; Kost and Knight, 1975; Mauchline, 1967, 1971a,b,c,&d, 1980; Pechen'-Finenko and Pavlovskaya, 1975; Wooldridge and Bailey, 1982).

The role of mysids as predators of zooplankton and/or harpacticoid copepods has been shown to be of considerable importance by a number of investigators, eg. Siegfried and Kopache (1980), Johnston and Lasenby (1982), Fulton III (1982a & b), Cooper and Goldman (1980, 1982), Murtaugh

(1981) and Bremer and Vijverberg (1982). Mysidopsis didelphys and M.gibbosa also appear to be predominantly carnivorous (Mauchline, 1970b).

Diel feeding rhythms have been observed for a few species, but not all species exhibit them. For example, Gastrosaccus psammodytes feeds more at night (Brown and Talbot, 1972), Siriella pacifica is a nocturnal predator in Californian kelp beds, but the co-occurring species Acanthomysis sculpta feeds by day and night (Hobson and Chess, 1976) as did M.relicta in experiments conducted by Cooper and Goldman (1980). As part of the 24-hour sampling sessions conducted in the current study, diel feeding patterns of Tenagomysis sp.2, Anisomysis mixta australis and Paramesopodopsis rufa were examined.

The interpretation of stomach contents is unfortunately largely subjective and several factors clearly can influence the results. Mauchline (1977) and Hyslop (1980) both discussed problems associated with the interpretation of gut content analysis. Several assumptions are usually made in the interpretation, for instance, if a predator does not swallow its prey in its entirety, problems and misinterpretation can arise. In particular, Mauchline (1980) refers to two papers, Tchindonova (1959) and Vinogradov (1962) in which these authors state that the mysids Petalophthalmus armiger, and Longithorax fuscus suck out the internal contents of their captured prey in the same way reported for euphausiids eating copepods (Mauchline and Fisher, 1969). Clearly, without the exoskeleton being ingested, the contribution to the diet of prey caught in this way could be grossly underestimated. Different rates of digestion of prey items can easily lead to the overemphasis of the slowly digested and resistant items (Mauchline, 1977). As with the majority of crustaceans (and many fish), the stomach contents of mysids are largely composed of unidentifiable particulate matter, usually referred to collectively as detritus. The importance of this unidentifiable component in the diet is all too easily overshadowed by lists of identified items in the gut (LeBrasseur and Stephens, 1965; Mauchline, 1977).

In view of these apparent shortcomings and the tedium associated with gut contents analysis, marine biologists have sought alternative methods for the delineation of food webs. A number of techniques have been employed with varying degrees of success. Of these, stable isotope analysis is proving itself to be potentially one of the most useful, since no manipulation of the food web is necessary and the analytical technique is relatively straightforward.

The basis of the technique, as discussed in detail by Fenton (1981), lies in the fact that an unequal partitioning or fractionation of

the isotopes of an element occurs during kinetic reactions. Of relevance to living organisms is the fractionation that occurs as a result of photosynthetic and chemosynthetic processes (Abelson and Hoering, 1961; Park and Epstein, 1961; Southward et al., 1981). Furthermore the different pathways of photosynthetic fixation result in quite different isotopic ratios (Tregunna et al., 1970; Smith and Epstein, 1971; Troughton et al., 1974). Although the isotopic ratios of plants result from fractionation occurring during photosynthesis, the isotopic composition of animals is primarily determined by their diet, providing a dietary history, i.e. isotopically "you are what you eat" (DeNiro and Epstein, 1978).

The main emphasis using this technique has been on the isotopes of carbon, $^{13}C:^{12}C$ (Fry and Parker, 1979; Fry et al., 1978, 1983; Haines, 1976; Haines and Montague, 1979; McConnaughey and McRoy 1979a&b; Peterson et al., 1980; Rau and Hedges, 1979; Thayer et al., 1978). However, to distinguish between food sources with similar carbon ratios, several workers have begun to examine nitrogen $^{15}N:^{14}N$, sulphur $^{34}S:^{32}S$ and/or hydrogen H:D ratios to provide a parallel source of information (Estep and Dabrowski, 1980; Estep and Hoering, 1980; Rau et al., 1981; Macko et al., 1983; Peterson et al., 1985). The advantage of using hydrogen ratios is due to the fact that fractionation of the two isotopes $^{1}H:^{2}H$ (or D) occurs to a greater extent than for any other pair since the mass difference between H and D is the largest relative difference possible (Friedman, 1953).

Although this is a widely used technique, within Australia very little has been done using stable isotopes to examine food webs. Two studies have been carried out in tropical waters in Northern Australia. Black and Bender (1976) examined carbon ratios of a range of marine organisms collected on the Great Barrier Reef, the emphasis being placed on photosynthetic organisms. More recently Fry et al. (1983) used carbon ratios to examine feeding relations within seagrass beds in the Torres Strait.

The analytical procedure to obtain the stable isotope ratios of organic material requires combustion to CO_2 and H_2O; the water must then be reduced to hydrogen gas. The isotopic ratio of the resultant gases (CO_2 and H_2) are then determined using a dual collecting mass spectrometer. A considerable amount of time was spent developing and designing a suitable combustion system in the present study. The method of combustion is crucial to the technique and several methods described in the literature were attempted until one was found that, with minor modifications, gave reliable results. The data obtained herein consequently can only be regarded as preliminary due to the developmental stage of this technique.

7.2 MATERIAL AND METHODS

7.2.1 MYSID GUT CONTENTS

The stomach contents of fifteen randomly selected adult individuals of each species (T.sp.2, A.mixta australis and P.rufa) in each month and for all times during the October 24-hour sampling session, were examined from site A. The sampling procedure is given in section 4.2.

Stomachs were carefully dissected out with fine needles under a binocular microscope. Dissected stomachs retained their almost spherical shapes even when empty, so that a visual estimate of the percentage fullness of each stomach was relatively easy to achieve. Each stomach was then dissected and the contents teased out onto a microscope slide and dispersed in glycerol. The prepared slides were examined at x100 and x200 magnification and the dietary components categorized as in Table 7.1. A visual estimate of the relative abundance of each prey items was recorded.

7.2.2 FISH GUT CONTENTS

A range of fish species present in the study site were collected during monthly and 24-hour sampling sessions. A Grab-all fish net (mesh size $10cm^2$) was set for 3-4 hours at the outermost edge of site A or C in the kelp at 90^o to the transect during all sampling sessions. During the 24-hour sampling sessions a seine net was hauled along the beach at 6-hourly intervals (1200, 1800, 0000, 0600 hours). All fish collected were stored frozen at -18^oC until dissection.

Species were identified according to Last et al. (1983). The stomachs and intestines of all fish were removed, dissected and examined for the presence of mysid species. Other items in the guts were also recorded and the percentage contribution of mysids to the total contents estimated.

7.2.3 STABLE ISOTOPE ANALYSIS

7.2.3.1 Sample Collection

A representative collection of the algae, phytoplankton, zooplankton, benthic invertebrates and fish present was prepared for analysis. Whole organisms were used when possible, sometimes several individuals were needed. For larger animals, muscle tissue was used (DeNiro and Epstein, 1978) and for macroalgae the sample taken was a cross section from half-way along the length of the algal frond. In view of the recent paper by Stephenson et al. (1984) detailing variability of the isotopic ratio within

a single frond, this method should have provided an average value of the isotopic variation occurring within the algae. The samples were placed in organically cleaned glass vials (chromic acid washed and rinsed with distilled water) and frozen immediately on dry-ice. Precombusted GF/C filters were used to collect phytoplankton and zooplankton samples. All samples were stored frozen at -20°C. The samples were later dried in a vacuum oven at 60°C for at least 48 hours and then stored in a desiccator prior to combustion.

7.2.3.2 Combustion of Samples

Initially, a design similar to that described by Schiegel and Vogel (1970) using an oxygen/gas torch for combustion was used. This system was developed, and preliminary samples analyzed by Fenton (1981), but combustion was not always complete. The system described by Parker et al. (1972) using a radio-frequency furnace was tried and proved to be an improvement on the previous method. However, incomplete combustion also occurred. Finally, by using a combustion system currently in use for sulphur isotope work (in this University), which incorporates a 900°C furnace, the problem of incomplete combustion was remedied. An additional improvement was achieved by using cuprous oxide as the oxygen source for combustion rather than cylinder oxygen, which was difficult to load accurately into the combustion chamber.

Combustion to CO_2 and H_2O vapour was achieved by mixing 15-20mg samples of organic material with approximately 500mg of Cu_2O [prepared according to the method of Robinson and Kasakabe, (1975)] in a combustion boat in a 900°C furnace. A second furnace containing Cu turnings at 600°C was in line with the combustion furnace. The two furnaces were isolated from the rest of the system for the 10min burn to allow conversion of the oxides of nitrogen to nitrogen gas. Products of combustion were then separated and collected.

The reduction of water vapour to hydrogen was carried out by repetitively passing the water vapour over hot uranium at 780°C and the resultant hydrogen adsorbed onto activated charcoal.

Both CO_2 and H_2 were analyzed on a Micromass 602C double collector mass spectrometer. The results are reported with respect to the standards $^{13}C_{PDB}$ and SMOW respectively, where

$$R = [(\text{ ratio of sample })/(\text{ ratio of standard }) - 1] \times 1000$$

Error is routinely less than $\pm 0.2^{o}/_{oo}$.

7.3 RESULTS

7.3.1 MYSID GUT CONTENTS ANALYSIS

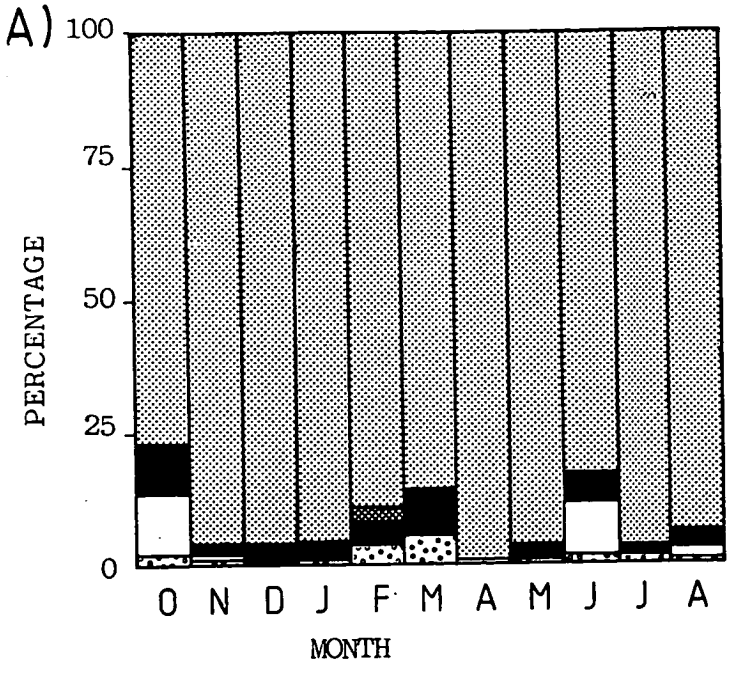
The percentage frequency of occurrence and percentage by volume of each prey item in the guts of T.sp.2, A.mixta australis and P.rufa are listed in Table 7.1. Diatoms were rarely observed in the mysid guts. The frequency of spores, including those of the pine tree Pinus radiata, sponge spicules and foraminifera found in the guts was low in the guts of T.sp.2 and P.rufa. However, spores (mainly of Pinus radiata) were the third most frequently observed prey item in the guts of A.mixta australis, but actually only were present in September and October. The most frequent items in the diet of A.mixta australis were unidentifiable particulate matter, crustaceans and dinoflagellates. Dinoflagellates, mainly Ceratium sp. were also often observed in the guts of T.sp.2, but were not found in P.rufa. Unidentified particulate matter, algal thallus, crustacean remains (including legs, mandibles and parts of the bodies of harpacticoid copepods) and algal filaments were the most commonly identified components in the stomachs of T.sp.2 and P.rufa. However, the relative frequency of crustacean remains in the guts of P.rufa was almost twice that observed for T.sp.2 and the number of stomach with algal thalli and filaments was lower for P.rufa.

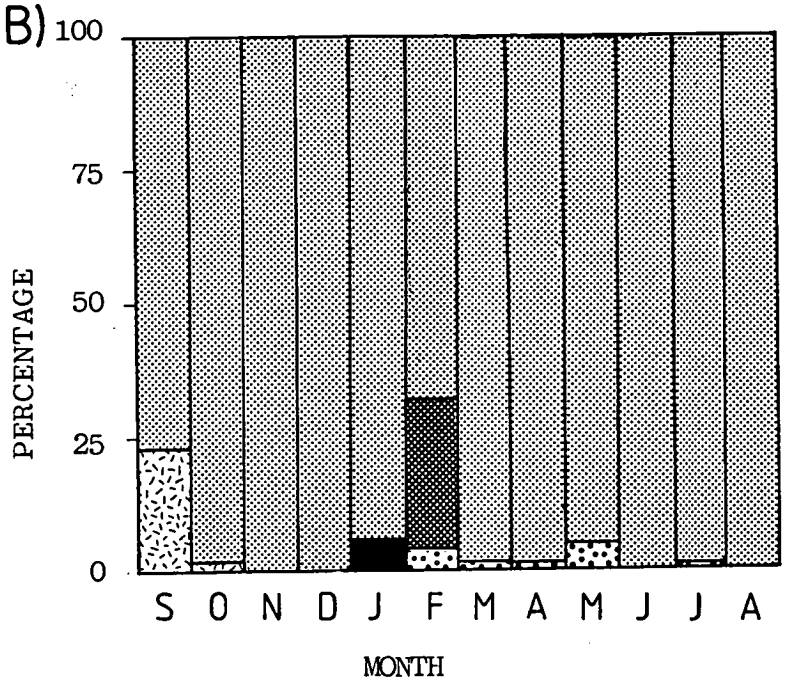
The percentage of each prey category in terms of volume is plotted for each month in Fig. 7.1. The gut contents of the three species under investigation was composed mainly of unidentified particulate matter, ranging from an average of 75% of the volume for P.rufa to over 90% for T.sp.2 and A.mixta australis. Consequently, only a small portion of the gut contents in terms of volume was identifiable. The identifiable fraction of the stomach contents of T.sp.2 consisted mainly of algal thallus, filaments and crustacean remains. The same dietary components also comprised most of the gut contents of P.rufa, with substantially more crustacean material present in the guts. In February, dinoflagellates Ceratium sp. were responsible for an average of 29% of the volume of A.mixta australis and for about 3% of T.sp.2 stomachs. In all months except February, dinoflagellates did not contribute more than 1% of the stomach content of T.sp.2 or A.mixta australis, and as already mentioned were never observed in the guts of P.rufa. The gut contents of A.mixta australis in September and to a lesser degree in October, had a considerable number of Pinus radiata spores. Crustacean remains were present in low percentages in the guts of A.mixta australis in most months, with slightly higher percentages observed from February to May.

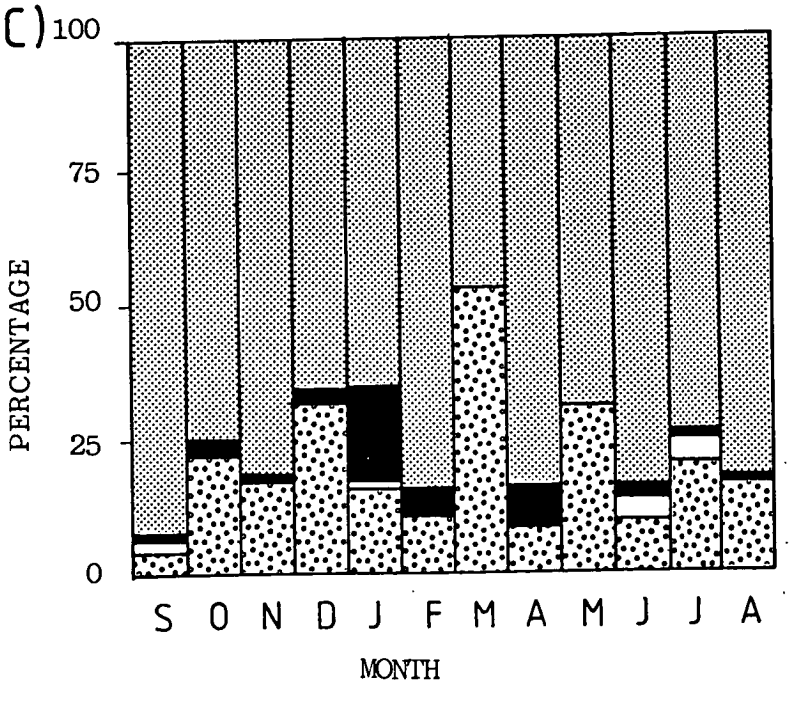
Table 7.1 The percentage frequency (%F) and percentage volume (%V) of the stomachs examined with each prey item.

PREY CATEGORY	T.sp.2		A.mixta australis		P.rufa	
	%F	%V	%F	%V	%F	%V
Diatoms	1.8	*	1.3	*	1.1	*
Algal thallus	46.7	*	6.0	0.56	27.8	3.78
Filaments	32.1	2.5	2.6	*	15.0	1.05
Crustacean	46.1	1.8	16.0	1.3	88.3	20.17
Dinoflagellates	26.1	0.6	12.7	2.5	-	-
Spores	7.8	*	13.2	2.1	3.3	*
Foraminifera	6.1	*	2.0	*	0.56	*
Sponge spicules	1.8	*	-	-	1.1	*
Unidentifiable particulate matter	100	90.76	100	92.47	100	74.99

* Categories contributing < 0.5% volume


A)
100
75
50
25
0
PERCENTAGE
O N D J F M A M J J A
MONTH


B)
100
75
50
25
0
PERCENTAGE
S O N D J F M A M J J A
MONTH


C)
100
75
50
25
0
PERCENTAGE
S O N D J F M A M J J A
MONTH

The average percentage fullness of guts in each month is represented in Fig. 7.2. Average fullness was above 30% for P.rufa, above 65% for T.sp.2, but usually below 40% for A.mixta australis.

7.3.2 DIEL MYSID FEEDING PATTERNS

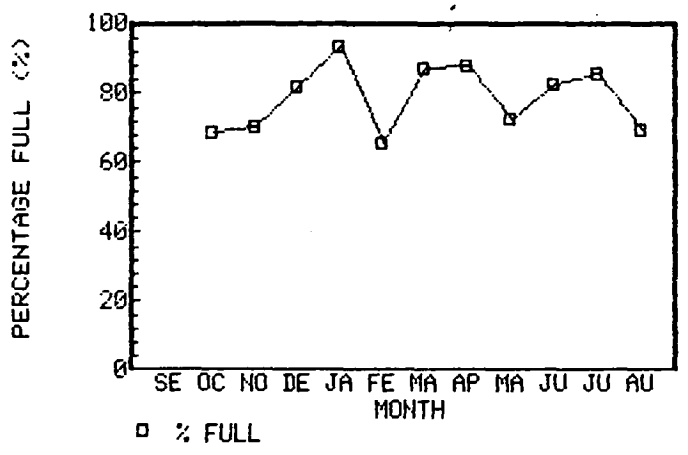
The stomachs of only the October 24-hour sampling session were dissected and examined due to time limitations.

Variation in the percentage fullness of stomachs was observed during the 24-hour period (Fig. 7.3). The stomachs of T.sp.2 were always above 60% full, but at night this tended to increase generally above 80%. There were insufficient numbers of T.sp.2 species collected at 0900hrs for dissection. Only very low numbers of A.mixta australis were collected at night in October, and consequently, feeding data for 2100, 0000 and 0300hrs are lacking. The daytime levels of stomach fullness were low (<20%), although a peak (30%) was observed at 0600hrs (sunrise). It is possible that the population of A.mixta australis was feeding at night, but in an area which was not sampled efficiently. This could easily happen if they moved out of the area immediately above the sediment, either up in the water column or down onto the sediment surface. During the January and April 24-hour sampling sessions, the density of A.mixta australis was much greater at night than in October (4.3.7). Whilst it is recognized that analysis of the January and April samples would have given further insight into feeding rhythms (particularly of A.mixta australis), it was unfortunate that time restrictions did not permit this. The stomach fullness of P.rufa was noticeably greater during the daytime and in the early evening (2100hrs) than at night and in the early morning. This would suggest that feeding at night is minimal.

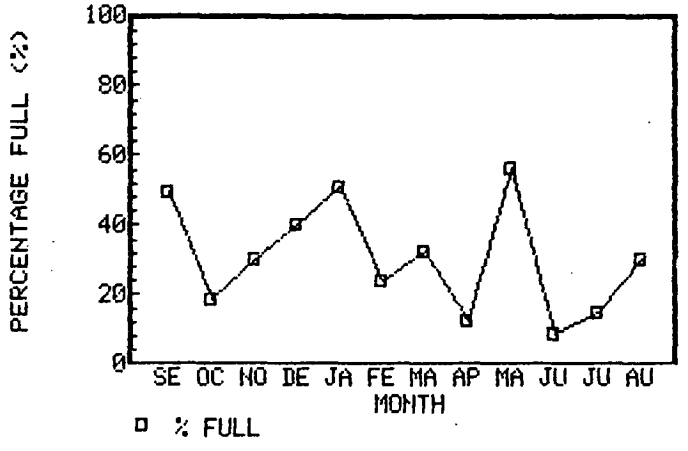
The percentage of material that could be identified in the stomachs of T.sp.2 and P.rufa varied during the 24-hour cycle (Fig. 7.4), which may also indicate time of feeding, by virtue of the stage of digestion. The contents of T.sp.2 stomachs was largely composed of algae, both thalli and filaments, but during the night the percentage by volume of crustaceans in the stomachs increased. At 2100hrs over 70% of the stomach contents could be identified, but by 0000hrs the level had dropped again to about 20%. At 1500 and 0600hrs, only a very small proportion of the contents was identifiable. It is interesting to note that the peak feeding time indicated by the degree to which the contents could be identified corresponded to low tide and the minimum to high tide. This obviously would be worth exploring in the future.

Crustacean remains were the major item which was identified in the

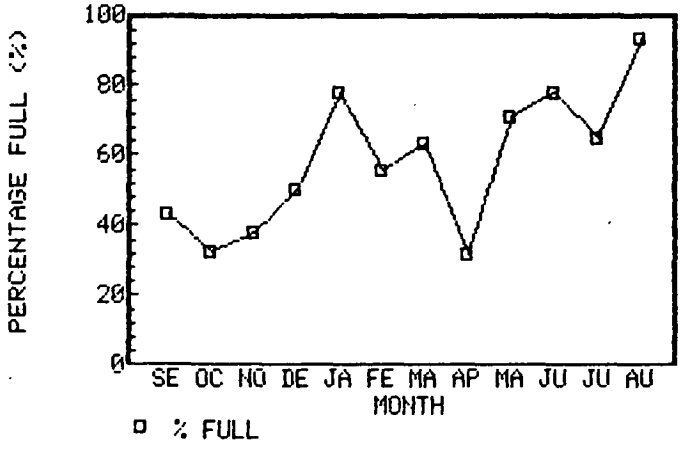
A)


PERCENTAGE FULL (%)
100
80
60
40
20
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
% FULL

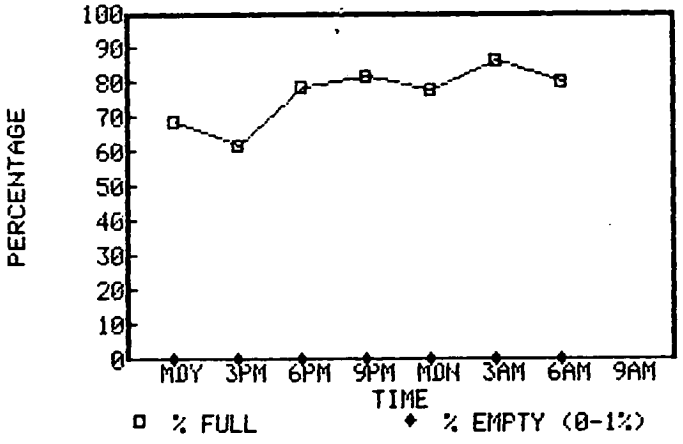
B)


PERCENTAGE FULL (%)
100
80
60
40
20
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
% FULL

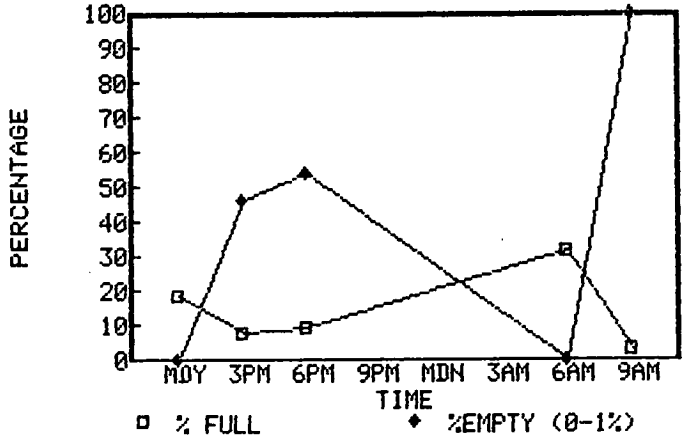
C)


PERCENTAGE FULL (%)
100
80
60
40
20
0
SE OC NO DE JA FE MA AP MA JU JU AU
MONTH
% FULL

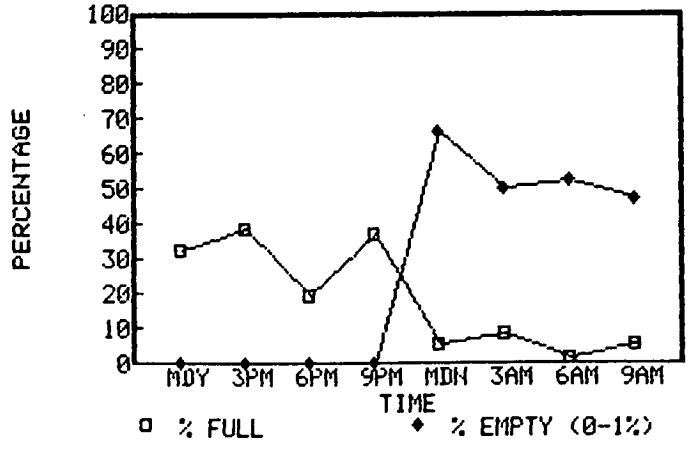
A)


PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
% FULL
% EMPTY (0-1%)

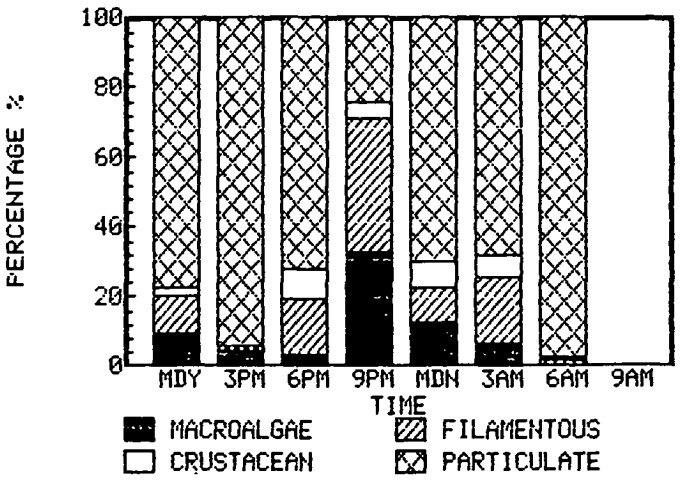
B)


PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
% FULL
%EMPTY (0-1%)

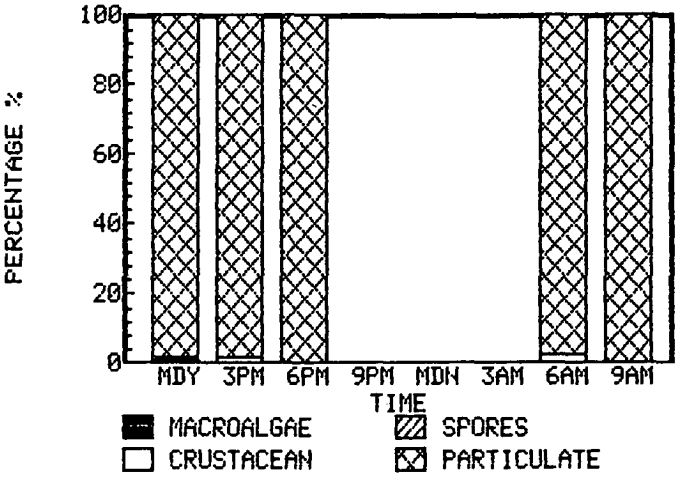
C)


PERCENTAGE
100
90
80
70
60
50
40
30
20
10
0
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
% FULL
% EMPTY (0-1%)

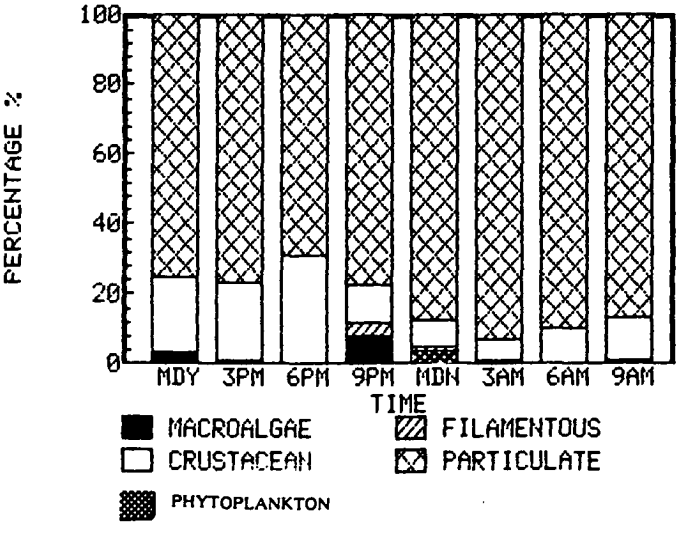
A)


100
80
60
40
20
0
PERCENTAGE %
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
MACROALGAE
FILAMENTOUS
CRUSTACEAN
PARTICULATE

B)


100
80
60
40
20
0
PERCENTAGE %
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
MACROALGAE
SPORES
CRUSTACEAN
PARTICULATE

C)


100
80
60
40
20
0
PERCENTAGE %
MDY 3PM 6PM 9PM MDN 3AM 6AM 9AM
TIME
MACROALGAE
FILAMENTOUS
CRUSTACEAN
PARTICULATE
PHYTOPLANKTON

guts of P.rufa throughout the 24-hour cycle. Algae, both thalli and filaments, contributed about half of the identifiable portion of the gut contents at 2100hrs; this may indicate a slight shift in the diet. This would appear to correspond with the increase in numbers caught at this time, which, as discussed in 4.3.7, may be a result of movement out to the edge of the algal zone and into the region where detrital algae accumulates. At 0000, phytoplankton appeared in the diet in a larger percentage than before; this was biased by the results for a single individual.

The stomach contents of A.mixta australis was virtually entirely particulate organic matter; few items were ever identified.

7.3.3 FISH GUT CONTENTS

A total of 184 fish guts were examined, spanning 20 species which were present at the study site (Table 7.2). Only the guts of 4 species, i.e. Arripis trutta (juvenile salmon) (Table 7.3), Aldrichetta forsteri (juvenile yellow-eyed mullet), Vincentia conspersa (cardinal fish) and Pseudolabrus fucicola (purple wrasse) contained mysids. In January at 0000hrs, all individuals of A.trutta contained many mysids in their stomachs together with the euphausiid Nyctiphanes australis and a few amphipods. The presence of the highly motile planktonic euphausiid N.australis in the bay was assumed to be a rare occurrence, breeding swarms were observed at 0300hrs in January.

Amphipods were also present in the study site in large numbers, and their contribution to fish gut contents was frequently high. Their role has not been assessed, but is likely to be significant, and would be worth exploring in terms of their utilization of macrophyte detritus (possible competition with mysids) and the degree to which their populations are predated upon by fish compared to the predation of mysid species.

It is somewhat surprising to find that of the mysids observed in the fish guts, no A.mixta australis were found and individuals of P.rufa were only found on two occasions in the gut of a yellow-eyed mullet (Aldrichetta forsteri) and a salmon. The majority of mysids found in fish guts belonged to the species Tenagomysis sp.1 which was taken in considerably greater numbers than its more abundant relative T.sp.2. Possibly, the abundance of T.sp.1 has been underestimated in the bay. Alternatively, perhaps T.sp.1 is merely more "catchable" by fish than the other mysids which may be related to its swarming ability. This will be discussed further in 7.4.

Table 7.2 Species of fish examined by gut contents analysis.

SCIENTIFIC NAME	COMMON NAME	n	NO. OF STOMACHS WITH FOOD	MYSIDS	AMPHIPODS	METHOD CAUGHT	MYSID SPECIES
Order GADIFORMES							
Pseudophycis bachus	Red cod	1	1	-	-	GA	
Order ATHERINIFORMES							
Family HEMIRAMPHIDAE							
Hyporhamphus melanochir	South Australian garfish	25	25	-	-	Seine	
Order SCORPAENIFORMES							
Family SCORPAENIDAE							
Scorpaena ergastulorum	Common red rock cod	1	1	-	1	Dredge	
Order PERCIFORMES							
Family APOGONIDAE							
Vincentia conspersa	Southern cardinalfish	2	2	1	2	FBA net	*T.sp.1* (50%) *T.sp.2* (17%)
Family ARRIPIDAE							
Arripis trutta	Eastern Australian salmon	104	92	41	55	Seine	See Table 7.3
Family APLODACTYLIDAE *Dactylosargus arctidens*	Marblefish	3	3	-	-	GA	
Family CHEILODACTYLIDAE							
Cheilodactylus spectabilis	Banded morwong	1	0	-	-	GA	
Family LATRIDAE							
Latridopsis forsteri	Bastard trumpeter	7	7	-	7	GA	
Family MUGILIDAE							
Aldrichetta forsteri	Yellow-eyed mullet	7	7	1	7	Seine	*P.rufa* (30%)
Family LABRIDAE							
Pictilabrus laticlavius	Senator Wrasse	2	-	-	-	GA	
Pseudolabrus fucicola	Purple Wrasse	4	4	1	2	Seine & GA	*T.sp.2* (29%)
Pseudolabrus tetricus	Blue-throated Wrasse	2	2	-	2	GA	
Family URANOSCOPIDAE							
Kathetostoma laeve	Common stargazer	1	1	-	-	GA	
Family LEPTOSCOPIDAE							
Crapatalus arenarius	Common sandfish	33	21	-	20	Seine	
Family CLINIDAE							
Heteroclinus perspicillatus	Common weedfish	1	1	-	1	Dredge	

Table 7.2 (Continued) Species of fish examined by gut contents analysis.

SCIENTIFIC NAME	COMMON NAME	n	NO. OF STOMACHS WITH FOOD	MYSIDS	AMPHIPODS	METHOD CAUGHT	MYSID SPECIES
Order PLEURONECTIFORMES							
Family PLEURONECTIDAE							
Ammotretis lituratus	Spotted flounder	3	2	-	2	Seine	
Order TETRAODONTIFORMES							
Family MONACANTHIDAE							
Meuschenia australis	Brown striped leatherjacket	1	1	-	-	FBA net	
Penicipelta vittiger	Toothbrush leatherjacket	7	6	-	-	FBA net	
Family OSTRACIONTIDAE							
Aracana aurita	Shaw's cowfish	1	1	-	1	FBA net	
Family DIODONTIDAE							
Diodon nicthemerus	Globefish	1	0	-	-	FBA net	
		Σ=207					

Note: GA = Grab-all fish net.

Table 7.3 Examination of Australian salmon stomachs collected at One Tree Point. Numbers in parentheses refer to the percentage volume of the stomach occupied by the specified food item.

TIME	NO. CAUGHT	NO. WITH				NO. OF STOMACHS WITH MYSIDS		
		FOOD	MYSIDS	AMPHIPODS	N.AUSTRALIS	T.sp.1	T.sp.2	P.rufa
October								
1800hrs	12	7	3 (100%)	3 (100%)	-	3	-	-
0000hrs	14	9	-	6 (100%)	-	-	-	-
0600hrs	1	1	-	1 (100%)	-	-	-	-
January								
0000hrs	22	22	22 (70%)	4 (1%)	19 (29%)	21	8	1
April								
1200hrs	16	14	10 (85%)	7 (77%)	-	10	1	-
0000hrs	27	27	1 (60%)	22 (92%)	-	1	-	-
0600hrs	12	12	5 (22%)	12 (91%)	-	2	3	-
TOTAL	104	92	41	55	19	37	12	1

7.3.4 STABLE ISOTOPE ANALYSIS

The stable isotope ratios are provided in Table 7.4, and the carbon and hydrogen values plotted separately in Figs. 7.5 and 7.6. The carbon results for the majority of the samples were in the range $\delta^{13}C = -18^{o}/_{oo}$ to $-23^{o}/_{oo}$. This included all phytoplankton, zooplankton, mysids, about 50% of the macroalgae and most other fauna.

Macroalgae as a group ranged from $\delta^{13}C = -32.2^{o}/_{oo}$ to $-16.9^{o}/_{oo}$. Of these, the brown algae were the most enriched in ^{13}C, the values being similar to those found by Smith and Epstein (1970) and Fry *et al.* (1982) for other brown algae species. A red alga *Plocamium sp.* ($\delta^{13}C = -32.1^{o}/_{oo}$) was, isotopically, the lightest sample found. This value, interestingly, is similar to that of an unidentified red alga found growing on mangrove roots at Cayos Miskitos by Fry *et al.* (1982), the $\delta^{13}C$ being even lower i.e. $-34.7^{o}/_{oo}$.

Samples of phytoplankton ranged in value from $\delta^{13}C = -18.6^{o}/_{oo}$ to $-20.5^{o}/_{oo}$. These values fall neatly into the graph produced by Sackett *et al.* (1973) for 11-12°C, the ambient temperature at the time of collection and about average for this locality. Their graph of the temperature dependence of the isotopic fractionation of $^{13}C:^{12}C$ was based on samples of phytoplankton collected from various latitudes.

Zooplankton samples ranged in $\delta^{13}C$ from $-20.5^{o}/_{oo}$ to $-23.7^{o}/_{oo}$. Those samples which were composed primarily of copepods, fell in the range $\delta^{13}C = -20.5^{o}/_{oo}$ to $-20.9^{o}/_{oo}$. According to McConnaughey and McRoy (1979a) animals are nearly always enriched in $\delta^{13}C$ compared to phytoplankton. Consequently, for zooplankton samples that are dominated by a single species, eg. *Nyctiphanes australis* with a $\delta^{13}C$ value of $-22.6^{o}/_{oo}$ which is isotopically lighter than phytoplankton, a dietary component other than the phytoplankton is indicated. However, the phytoplankton samples are a heterogenous assemblage so that the $\delta^{13}C$ value is an average of all species. The results of Wong and Sackett (1978) have shown species specific isotopic ratios varying up to $13.4^{o}/_{oo}$ for a range of phytoplankton species cultured under identical conditions. If selective feeding by zooplankton is occurring, a $\delta^{13}C$ value lighter than the average $\delta^{13}C$ of phytoplankton does not necessarily rule out the possibility of some species of phytoplankton being exploited as food sources.

Benthic crustaceans analyzed show the expected trend of $\delta^{13}C$ enrichment compared to the more pelagic ones (McConnaughey and McRoy, 1979a). Isotopic values for planktonic squid ($\delta^{13}C = -19.65^{o}/_{oo}$) suggests predation on other plankters. Isotopically heaviest of all animals analyzed are the two echinoderms; *Ophionereis sp.* (brittle-star) ($\delta^{13}C = -11.75$) and

Table 7.4 Hydrogen and carbon isotope values for algae and fauna collected at One Tree Point.

SAMPLE	$\delta D^{o}/_{oo}$	$\delta^{13}C^{o}/_{oo}$	DATE
Phytoplankton	-73	-19.0	(11-8-82)
	-87	-20.5	(1-9-81)*
		-18.6	(23-7-81)*
Zooplankton	-25	-20.6	(14-5-83)
	-57	-22.0	(15-9-82)
	-76	-20.9	(16-7-81)
	-70	-20.5	
Lucifer hanseni		-23.7*	
Nyctiphanes australis		-22.6	
Algae			
Lessonia corrugata		-16.9	
Plocamium angustum		-32.2	
Ulva sp.		-18.7	
Cystophora sp.		-23.6	
Codium fragile	-91.7	-24.5	
Ecklonia radiata	-76	-18.4	
"Crinoid" algae	-87.6	-22.0	
Jeannerettia (detrital)	-70	-27.8	
Mysids			
P.rufa	-67	-20.6	
		-21.3	
T.sp.2	-47	-19.3	
A.mixta australis	-54	-19.2	
Fish			
Hyporhamphus melanochir garfish	-89.1	-22.8	
Heteroclinus perspicillatus common weedfish	-66.5	-21.0	
Aldrichetta forsteri yellow-eyed mullet	-81.3	-18.9	
Ammotretis lituratus (adult) flounder	-42.8	-17.2	
(juvenile)	-35	-19.4	
Crapatalus arenarius common sandfish	-47.9	-18.7	
Phyllopteryx taeniolatus weedy seadragon	-36.7	-17.1	
Arripis trutta (juvenile) Australian salmon	-44	-20.1	
		-20.1	
Other fauna			
Alpheus richardsoni snapping shrimp		-18.0	
Tanaid sp.	-86	-18.6	
Ovalipes sp. swimmer crab	-82.0	-18.3	
squid	-90.5	-19.7	
Aporometra sp. crinoid	-85.1	-15.2	
Ophionereis sp. brittle star	-104.0	-11.8	

* These values are from Fenton (1981)

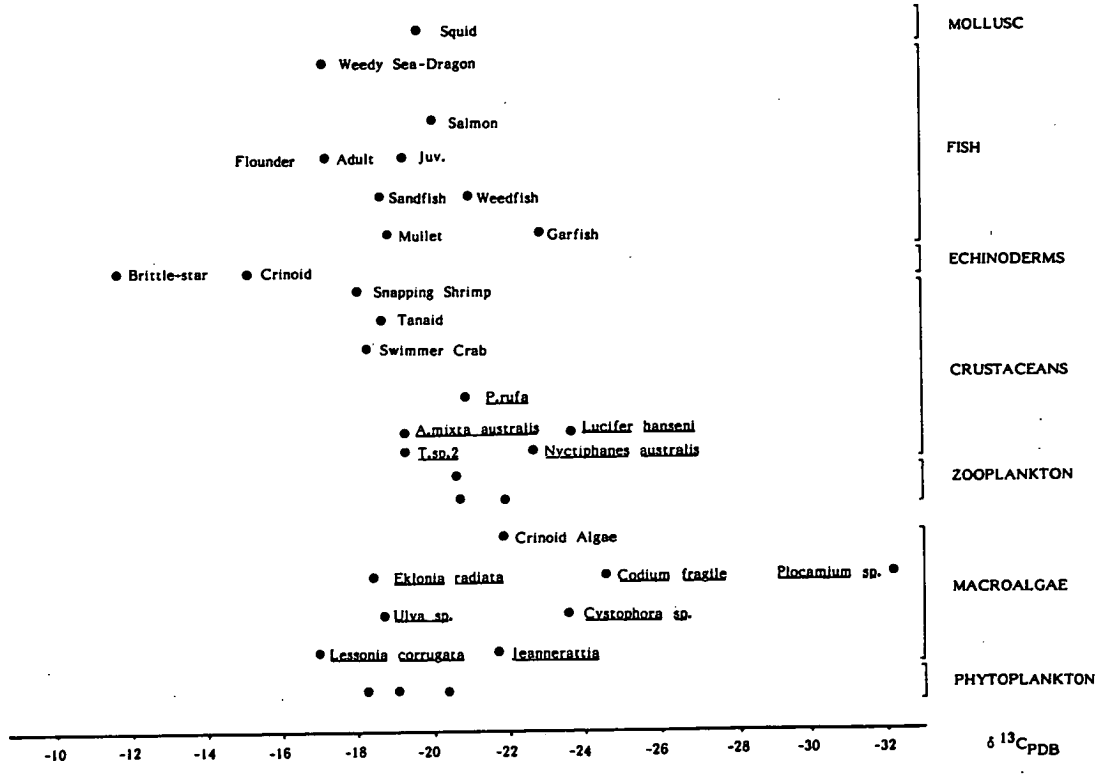


Fig. 7.5 Carbon isotope ratio results.

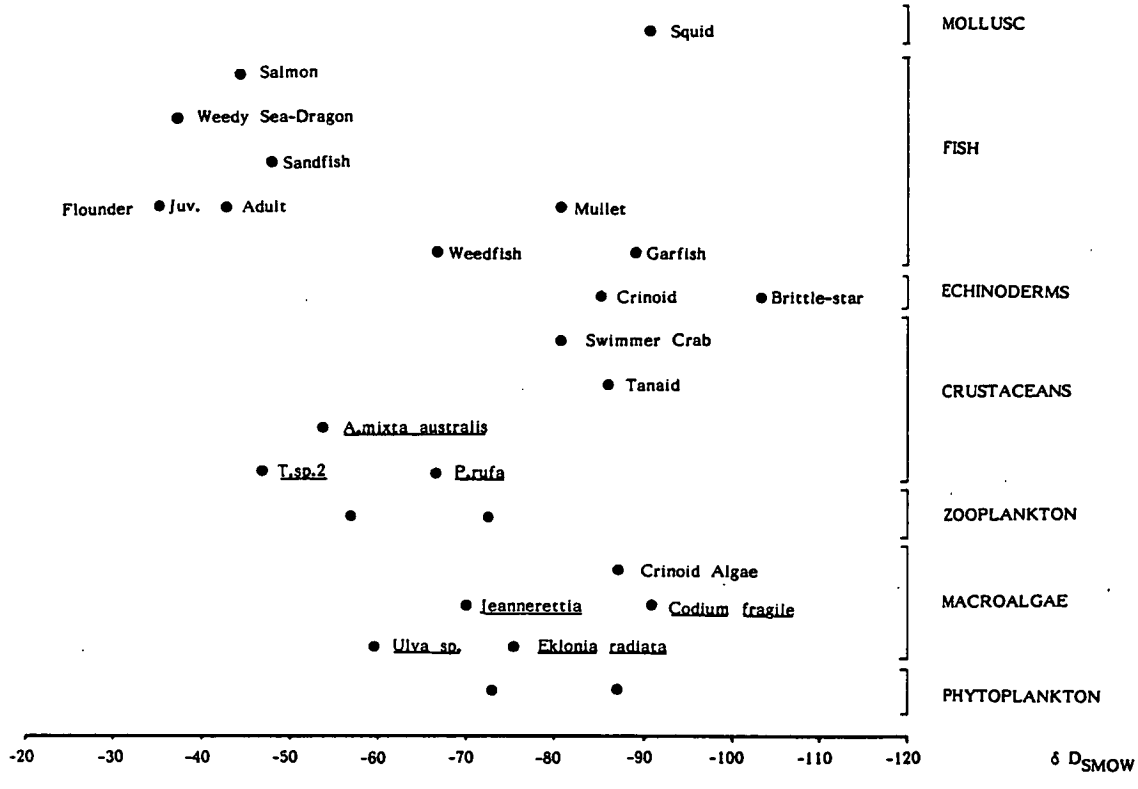


Fig. 7.6 Hydrogen isotope ratio results.

Aporometra sp. (crinoid) ($\delta^{13}C = -15.18^{o}/_{oo}$). Since carbonate was not removed before combustion, their true organic carbon value is masked. However, Fry et al. (1982) reported values for two brittle-star species of $\delta^{13}C = -8.5^{o}/_{oo}$ and $-9.0^{o}/_{oo}$, where calcium carbonate was removed by pretreatment with acid. Notably, they are fairly similar to the values reported here. In this context, Froelich (1980) warned against acid treatment of sediments to remove inorganic carbon, since he found that between 5-45% of the organic carbon was solubilized and lost by this pretreatment.

The carbon isotope ratios for T.sp.2 and A.mixta australis are almost identical and would suggest they have a very similar diet, whereas, P.rufa appears isotopically lighter and closer to the value obtained for zooplankton. McConnaughey and McRoy (1979a) reported a carbon value of $-19.4^{o}/_{oo}$ for the mysid Neomysis raschii in the Bering Sea, which is quite similar to that obtained for T.sp.2 and A.mixta australis here.

Several fish species were analyzed, their carbon ratios falling in the range $\delta^{13}C = -17.1^{o}/_{oo}$ to $-22.8^{o}/_{oo}$. The value for garfish Hyporhamphus melanochir $\delta^{13}C = -22.8^{o}/_{oo}$ indicates a planktonic diet. Gut contents analysis of this species carried out by Last (1983) indicated a diet comprising seagrass, copepoda, cladocera, miscellaneous crustacean and animal remains. However, the majority of the gut contained digested material that could not be identified. If, as suggested by gut contents, seagrass is a major component of the diet, the carbon ratio certainly does not reflect the values for the seagrass species known to occur in Tasmania i.e. Heterozostera tasmanica $\delta^{13}C = -12.1^{o}/_{oo}$, Posidonia australis $\delta^{13}C = -8.8^{o}/_{oo}$, Amphibolus antarctica $\delta^{13}C = -12.2^{o}/_{oo}$ (McMillan et al., 1980). The copepod content of the diet observed has quite possibly been underestimated since the isotopic ratio observed more closely reflects that of a planktonic diet. A recent paper by Robertson and Klumpp (1983) reported that H.melanochir was a diurnal herbivore but nocturnally a carnivore feeding largely on amphipods. Quite possibly the large swarms of mysid T.sp.2 and A.mixta australis are major components in the diet of common sandfish, yellow-eyed mullet Aldrichetta forsteri, flounder Ammotretis lituratus and juvenile salmon Arripis trutta. Although Last (1983) found mysids present in the gut contents of most of these species, other prey items were considered more important. On the other hand, the common weedfish Heteroclinus perspicillatus and salmon are implicated as predators of the more pelagic mysid P.rufa.

Although the carbon results provide some clues to the dietary relations present, the clustering of the majority of the values between $\delta^{13}C = -18^{o}/_{oo}$ and $-23^{o}/_{oo}$ clearly limits the utility of $\delta^{13}C$ alone in

distinguishing specific links in the food web. In contrast, the hydrogen results tend to spread out the values and provide a clearer picture of the food web. On the whole, the H:D values found are similar to those found in other coastal temperate waters (Smith and Epstein, 1970; Rau et al., 1981).

The values for phytoplankton $\delta D = -73^{o}/_{oo}$ to $-87.6^{o}/_{oo}$ are very similar in range to a value of $\delta D = -83^{o}/_{oo}$ reported by Estep and Hoering (1980) for phytoplankton. Zooplankton samples dominated by copepods again reflected phytoplankton values $\delta D = -70^{o}/_{oo}$ to $-76^{o}/_{oo}$, but the zooplankton sample taken 15.9.82 ($\delta D = -57^{o}/_{oo}$) suggests a quite different diet. The mysid P.rufa ($\delta D = -67^{o}/_{oo}$) again appears to feed on plankton although this value does not eliminate the possibilty of macroalgae contributing to the diet. The other two mysid species, T.sp.2 ($\delta D = -47^{o}/_{oo}$) and A.mixta australis ($\delta D = -54^{o}/_{oo}$), again show a clear difference in diet to P.rufa, but are remarkably similar to each other as they were for the carbon results. The common weedfish ($\delta D = -66.5^{o}/_{oo}$) is again implicated as a predator of P.rufa, and salmon, weedy seadragon (Phyllopteryx taeniolatus) and flounder (Ammotretis lituratus) are suggested as likely predators of T.sp.2 and A.mixta australis.

One of the major advantages of hydrogen isotopes is that the inorganic carbonate content of the samples should not affect the isotopic ratios. This is perhaps best exemplified by results for the crinoid Aporometra sp. From the carbon result little could be determined about the diet but with hydrogen, ($\delta D = -85^{o}/_{oo}$) it would appear that the host alga ($\delta D = -87.6^{o}/_{oo}$) is the major food source. This may take the form of feeding on suspended particles of the disintegrating fronds (LaTouche, 1978), or on exudates.

Garfish and squid, $\delta D = -89.1^{o}/_{oo}$ and $-90.5^{o}/_{oo}$ respectively, probably have diets based on plankton, whereas tanaids $\delta D = -86^{o}/_{oo}$, swimmer crab Ovalipes $\delta D = -81.9^{o}/_{oo}$ and mullet $\delta D = -81.3^{o}/_{oo}$ may also feed on plankton but feeding on macroalgae or on intermediate animals feeding on either cannot be ruled out.

7.4 DISCUSSION

T.sp.2, A.mixta australis and P.rufa all appear to be omnivorous but the extent to which different components contribute to their diets vary. The stomach contents of A.mixta australis was mainly composed of finely particulate unidentifiable material throughout the year, although dinoflagellates, spores, macroalgal fragments and crustacean remains were present in small quantities. The dominance of particulate matter in the

stomachs of A.mixta australis suggests that they feed predominantly on suspended matter or on the substrate surface, similar to the diet reported for Paramysis arenosa (Mauchline, 1971a). In contrast, the larger species T.sp.2 and P.rufa appear to feed raptorially on larger food items more of the time, such as harpacticoid copepods, other small copepods, crustaceans and fragments of macroalgae. However, the contribution of crustaceans in the diet of P.rufa was greater than that found for T.sp.2. Macroalgae, filamentous algae and dinoflagellates were commonly found in the guts of T.sp.2.

The stable isotope results also reflect the difference between P.rufa and T.sp.2, suggesting the diet of P.rufa has a planktonic basis. Isotopically (both hydrogen and carbon) A.mixta australis and T.sp.2 are quite similar, suggesting similar dietary sources. Despite this, the gut contents suggest ingestion is of different sized particles. This is significant in terms of resource utilization, since it suggests size selectivity. Detailed examination of the feeding methods in terms of behaviour and mechanistic properties of the mouthparts and feeding apparatus would be worthwhile to investigate, since little is really known of the feeding process of mysids (Mauchline, 1980; Attramadal, 1981).

No apparent diel feeding rhythm was observed for T.sp.2, but P.rufa appears to feed more during the day, based on changes in gut fullness and numbers of empty guts found. However, Murtaugh (1984) recently studied the gut residence time of Neomysis mercedis and found it to be extremely variable and negatively correlated with ingestion rate, similar to previous suggestions of Grossnickle (1982) for Mysis relicta. This has an important bearing on the examination of feeding rhythms based on stomach fullness since a constant gut residence time is assumed; small diel changes in stomach fullness may not actually indicate continuous feeding but may be due to variable residence time thus hiding a true circadian rhythm (Murtaugh, 1984).

From the composition of the diet throughout a 24-hour sampling period, the changes in the amount of material which could be identified may actually provide a more accurate assessment of periods of active feeding. On this basis, periodicity is indicated for T.sp.2, with more active feeding at night with a peak at 2100hrs (low tide) and at a low level at 1500 and 0600hrs corresponding to high tides. Examination of the stomach contents of mysids collected during the other 24-hour sampling sessions is required to further analyse the influence of the circadian and tidal rhythms on feeding intensity and diet, especially to determine the situation for A.mixta australis, which could not be elucidated from the Oct-

ober 24-hour sampling session.

Mauchline (1980) provides a detailed list of organisms known to be predators of mysids including ctenophores, gastropod snails, ostracods, isopods, amphipods, numerous decapods, fish, birds, whales and seals. In Australia, the scorpion fish Centropogon australis (White) has been reported to include considerable quantities of the mysid Australomysis sp. in its diet (Bell et al., 1978); the rock flathead Platycephalus laevigutus was reported to consume small numbers of mysids (Klumpp and Nichols, 1983). In addition, two deep-water fish species i.e. trevalla Hyperglyphe antarctica and king dory Cyttus traversi have been found with Gnathophausia ingens and Boreomysis sibogae respectively in their stomachs (Chapter 2). Furthermore, mysids are also known to predate on other mysids, for example Wooldridge and Bailey (1982) reported that the mysid Mesopodopsis slabberi was a frequent item in the omnivorous diet of the co-occurring mysid species Rhopalophthalmus terranatalis in the Sundays Estuary in South Africa. No evidence of predation between the mysid species at One Tree Point was found.

The importance of coastal mysid species in the diets of many commercially exploited fish species, and particularly by their juveniles using the shallow waters of coastal bays and estuaries as nursery grounds, has frequently been observed. In southern Tasmania in an open estuarine lagoon, newly metamorphosed flounder, Ammotretis rostratus and to a lesser extent Rhombosolea tapirina, fed on mysids (species not determined) during summer (Crawford, 1984). Mysids were implicated in the diet of the flounder Ammotretis liturata by stable isotope analysis in the present study, although only two guts of this species were examined and contained amphipods. Juvenile salmon (Arripis trutta) in an eelgrass community in Victoria were at times found to consume mysids in large quantities, particularly during the day, together with amphipods and small fish (Robertson, 1982). Diel dietary changes were observed with shrimps more important in the diet at night. In the present investigation mysids, mainly T.sp.1, were present in the stomachs of A.trutta during the day and night. The high frequency of T.sp.1 in the diet of A.trutta was surprising, since the density of this species in the bay was much lower than that of the other mysid species (4.3.3). Hobson and Chess (1978) also found that, despite mysids occurring in high densities, few were ever found in the stomachs of planktiverous fish during the day, however at night large numbers of mysids were eaten. Mauchline (1980) discussed these results and suggested that this was evidence of the protection against predation achieved by daytime swarming. This is quite possibly a realistic explanation of the low number

of fish found with the swarming mysids T.sp.2, A.mixta australis and P.rufa in their guts. T.sp.1 was only rarely observed swarming at the study site; most often it was observed resting on the sand (pers. obs.), but as a consequence, the density of this species may have been underestimated since the net did not sample the sediment surface. In addition, T.sp.1 is characteristically dark coloured. Kislalioglu and Gibson (1976) studied prey selection by the 15-spined stickleback Spinachia spinachia feeding on the mysids Neomysis integer and Praunus flexuosus and found that selection took place mediated by stimuli in the following order of effectiveness: movement > length > colour > shape. Moving prey were more frequently taken than stationary animals and dark coloured prey were preferentially selected. Possibly, the dark colour of T.sp.1, together with its slightly larger body size compared to the other mysids present, may contribute to its more common occurrence in the diet of predators at One Tree Point.

Mysids, T.sp.1 and T.sp.2, were present in the stomach of one of the two individuals of the cardinal fish (Vincentia conspersa) examined. In Japan, Azeta et al. (1983) found that the nocturnally active cardinal fish Apogon semilineatus fed largely on amphipods and mysids. The only other fish species collected in the current study which contained mysids (together with amphipods and isopods) was a juvenile yellow-eyed mullet (Aldrichetta forsteri). The isotope analysis also implicated this species, and a few other species including the weedy seadragon Phyllopteryx taeniolatus, common weedfish Heteroclinus perspicillatus and common sandfish Crapatalus arenarius. Mysids are regarded as the most important component in the diet of the weedy seadragon (Last et al., 1983).

Further isotopic analysis is required together with further gut contents analysis of predators, but despite the low number of results obtained here by stable isotope analysis, the value of this method is nevertheless evident. It appears to be particularly useful for examining animals which can only be obtained in very low numbers, and those for which diet is difficult to determine by gut contents by virtue of the number of empty stomachs usually encountered. Thus for an individual with an empty stomach, little can be determined about its diet, but by stable isotope analysis the probable food sources may be indicated. Furthermore, only a very small sample of organic material is required ($\simeq$20mg), so that the animal may not necessarily have to be sacrificed. For instance, a blood sample may, in some cases, be quite adequate (Steele and Daniel, 1978).

Several possible links in the food web have been suggested by the stable isotope analysis described. The importance of using at least two stable isotope ratios as tracers is stressed to provide parallel sources of

information. Although the isotopic technique provides a dietary history of a consumer, it is necessary to investigate the actual turnover rate of body carbon or hydrogen. This is important in order to assess the time span that the isotopic values refer to, especially since dietary changes may occur ontogenetically and seasonally. Moreover, the possibility of differential digestion of specific chemical components of food sources must be considered (Macko et al., 1983). The effect of mixed diets on the isotopic ratio may if, two isotopically quite distinct items are consumed, produce an average value which reflects neither food source. Part of the difficulty, particularly for planktonic and detrital feeders, lies is sampling their food sources accurately. As already mentioned in 7.3.4, the individual components which make up the zooplankton, phytoplankton and detrital macroalgae samples need to be analyzed separately, since not all components of these assemblages would be equally preferred or available to consumers. Therefore, when interpreting isotopic results some direct knowledge of the mode of feeding and potential food sources the animal is capable of exploiting is clearly desirable, if not essential. Even though the results may not always provide clear cut links in the food web, they may serve to eliminate some possibilities and indicate areas for further investigation.

The mysids examined here, as with most coastal mysids (Mauchline, 1980), are implicated as having an important role in the turnover of the macrophyte biomass. By reducing the particle size of this material they increase the surface area which can be colonized by microorganisms (Mann, 1972), in much the same way as do amphipods and isopods (Robertson and Mann, 1980). Macroalgae are thought to be colonized rapidly by bacteria and fungi when parts become detached from the living plant, and it is the micro-flora of the algae which provides the grazing detritivores their nourishment (Mann, 1972). The algae pass through the gut virtually unchanged except for reduction in particle size (Hargrave, 1970; Yigst, 1976). However, if direct utilization of the cellulose from the macroalgae occurs, the efficiency of energy transfer would be greatly increased (Mann, 1972).

Foulds and Mann (1978) examined the ability of Mysis stenolepis to digest cellulose. They found that assimilation efficiencies were greater for sterile food compared to non-sterile food. This implied that the mysid was either producing its own cellulases or had a gut micro-flora. Wainwright and Mann (1982) continued this work, and found that if the mysids were fed an anti-microbial substance the ability to assimilate cellulose was lost, indicating the presence of a gut micro-flora. On the other hand,

according to Mann (1982), Frieson (1981) was unable to find a gut-flora in Mysis stenolepis. It would therefore be of considerable value to determine whether the coastal mysid species under investigation here, are able to digest the macroalgae directly, or whether they feed on microorganisms which presumably coat disintegrating algae.

In addition to mysids assisting with the turnover of the macroalgal biomass, predation on harpacticoid and planktonic copepods by P.rufa, and to a lesser extent by T.sp.2, was occurring. Their role may also be important in the structuring of the zooplankton and/or meiobenthos community similar to the observed role of Neomysis mercedis in Lake Washington (Murtaugh, 1981) and in the Fraser River Estuary (Johnston and Lasenby, 1982). A similar role is reported for Mysis relicta in lakes where it has been introduced (Cooper and Goldman, 1980, 1982; reviewed by Grossnickle, 1982) and experimentally examined by Vanderploeg et al. (1982), Bowers and Vanderploeg (1982) and Folt et al. (1982).

The role of mysids is potentially very important in this nearshore environment, by their involvement in the turnover of the macrophyte biomass, possible influence on planktonic and benthic community structure and by their contribution to the diet of several fish species.

7.5 SUMMARY

1. The diets of the mysids T.sp.2, A.mixta australis and P.rufa were investigated together with a number of potential fish predators by gut contents and stable isotope analysis (using carbon and hydrogen ratios).

2. Monthly mysid gut contents analysis revealed an omnivorous diet, although the stomachs of P.rufa contained a greater percentage of crustacean remains, whereas the stomachs of T.sp.2 were largely composed of macroalgae. The stomachs of A.mixta australis were composed mainly of fine particulate matter.

3. Diel feeding rhythms were examined from the mysids collected during the October 24-hour sampling session. P.rufa appeared to be primarily a day-time feeder while T.sp.2 fed more intensively at night. The results for A.mixta australis were inconclusive.

4. Gut contents analysis of fish collected at the study site revealed predation on mysids by four species, viz, Arripis trutta (juveniles), Aldrichetta forsteri, Vincentia conspersa and Pseudolabrus fucicola. The mysid species most frequently consumed was T.sp.1. Possible reasons for the importance of this less abundant mysid species in the diet of these fish are discussed.

5. The mysid food web relations were also examined by analysing the stable isotope ratios of carbon and hydrogen in the mysids, their possible food sources and potential predators. A range of combustion methods were attempted until a reliable system was found. Results obtained supported the findings of the gut contents analysis. The isotopic results indicated that the diets of A.mixta australis and T.sp.2 were essentially the same (although A.mixta australis consumed a smaller particle size). In addition the isotopic results implicated several other fish species as mysid predators.

6. The dietary analysis indicate that these mysids are involved in the turnover of the macroalgae biomass, together with a possible influence on the structure of the zooplankton and/or meiobenthic communities by predation, and in turn, the mysids contribute to the diet of several fish predators.

CHAPTER 8

GENERAL DISCUSSION

Despite increased interest in mysids elsewhere in the world, very little is known about the species or their biology within Australia, although records of mysids in the diet of several fish predators suggest they may be important in coastal food webs (Bell et al., 1978; Robertson, 1982; Last, 1983). In view of this, the aims of the present project were firstly to compile a practical taxonomic treatment of species known from Australia and examine their distribution; and secondly to examine the role of mysids in a relatively isolated coastal community at One Tree Point in southern Tasmania.

The 12 month sampling program, including three 24-hour sampling sessions, resulted in a total of 14 mysid species of which three, T.sp.2, A.mixta australis and P.rufa dominated the samples in terms of abundance. These three species were consistently observed forming swarms, which were always associated with the algal fringe on both sides of the bay. These species were also found in the middle of the bay, but in low densities. The co-existence of these three species in a relatively narrow zone of occurrence was in itself very interesting. For these species to occur together, a degree of habitat partitioning and differences in their resource utilization would be expected from the competitive exclusion principle of Hardin (1960; p.1292) i.e. "Complete competitors cannot co-exist." The means by which species are able to co-exist has been the subject of many studies (Schoener, 1974). Evidence of resource partitioning or niche separation among co-existing species has largely been discussed as having been generated by interspecific competition, either exploitative or interference (Pianka, 1981). There are, however, alternative explanations. Predation, unpredictable disturbances and changing environmental conditions can prevent competitive equilibrium being reached (Hutchinson, 1961; Connell, 1975; Menge and Sutherland, 1976), thus resource partitioning can be irrelevant to species' co-existence (MacArthur, 1972). Nevertheless, examination of difference in resource utilization continues to provide insight into community organization (Hines, 1982).

The mysid species examined in the present study showed evidence of resource partitioning in terms of their habitat, diet and time of activity. Distinct habitat separation or zonation was observed such that each species

maintained monospecific swarms in a slightly different part of their habitat. P.rufa was present above the algae, T.sp.2 and A.mixta australis at the algae/sand interface, with A.mixta australis slightly higher in the water column above the algae and T.sp.2 above the sand. Intraspecific zonation of mysids has frequently been recorded (Clutter, 1967, 1969; Mauchline, 1971, 1980; Wittmann, 1977; Wooldridge, 1981; Zelickman, 1974). Clutter (1967) examined factors which might explain the zonation of mysids in La Jolla Bight, California. By rearing all species involved under identical laboratory conditions, he concluded that the zonation observed was a result of competition for space rather than food, but he was unable to determine the mechanism for this exclusion. The combination of zonation and swarming observed among mysid species suggests that it is partly responsible for population control and regulation (Clutter, 1969), but more information is needed before useful conclusions can be drawn (Mauchline, 1980).

The zonation of T.sp.2, A.mixta australis and P.rufa was also reflected in their diets, although all three were basically omnivorous. T.sp.2 and A.mixta australis were isotopically similar in composition (^{13}C:^{12}C and H:D), suggesting their dietary sources of carbon and hydrogen were essentially the same. However, some degree of resource partitioning was apparent from their gut contents, such that T.sp.2 ingested larger fragments of macroalgae, whereas A.mixta australis mainly ingested fine particulate matter. This difference reflected their habitat position at the study site, i.e. T.sp.2 occurred mainly above the sand at the edge of the algal fringe where disintegrating algae collected, whereas A.mixta australis maintained its position above the algal/sand interface. The turbulence of the environment may have helped to maintain a supply of suspended matter in the water column for A.mixta australis. Additional evidence is needed however, to determine whether this apparent difference in size of particulate food is as a result of selective ingestion of a specific size range of particles, or whether the mouthparts of A.mixta australis are more efficient at macerating the food. P.rufa, on the other hand was isotopically distinct from T.sp.2 and A.mixta australis. Gut contents were composed largely of small crustaceans, mainly copepods, and isotopic analysis also suggested a more carnivorous diet. Thus this mysid possibly feeds planktonically, although macroalgal fragments were also commonly observed in the stomachs of P.rufa. The diet of these three species indicates that their role in the community is similar to that described for many inshore coastal mysid species throughout the world (Mauchline, 1980), i.e. they appear to be important in the turnover of the

macroalgal biomass and play a role in structuring the zooplankton and/or meiobenthic communities.

An additional parameter frequently discussed in relation to the co-existence of ecologically similar species is body size. Hutchinson (1959) predicted that the ratio of the mean body size of co-existing species should be at least 1.28. Such size differences are usually interpreted as a reflection of the limits of resource utilization, for example, prey size or microhabitat (Hines, 1982). In the case of the mysid species studied here, body size also differed. P.rufa was the largest followed by T.sp.2 and A.mixta australis. The annual mean female body length of each species carrying each type of young gave the following values (see Appendices C1-3 for means). T.sp.2 and A.mixta australis differed by a ratio of 1.27-1.33 and P.rufa from T.sp.2 by between 1.32-1.36. The difference between P.rufa (the largest species) and A.mixta australis ranged between 1.70-1.76. Therefore, the mysids also separate in terms of body size. The reason for this is probably a trophic separation (size of prey) rather than microhabitat usage, since all the species swarm in the water column.

In seasonal terms, these three species exhibit population changes typical of the majority of iteroparous temperate mysid species (Mauchline, 1980; Wittmann, 1984). All are warm season breeders, with a winter depression, and in the case of A.mixta australis, a break in the breeding cycle. The strong seasonal variation of mysid abundance in temperate climates is thought to occur predominantly as a direct response to changes in food availability. The duration and timing of breeding appear to be adaptations to ensure that young are released when there is ample food available for development (Wittmann, 1984). Although it is doubtful whether food is ever a limiting factor in a detrital based food web, since the standing stock remains high (Lenz, 1977), the quality of the food, eg. microbial colonization, may vary seasonally (Thorp, 1976). The strong seasonality of mysid abundance to the extent that the number of young produced per female and the size at maturation vary seasonally, would certainly suggest seasonal variation in food supply (Wenner, 1974). This may be partly due to the availability of food to the juveniles in the population, since the diet of juvenile mysids may involve more overlap than that of adults, as their smaller size probably limit their potential food sources (Schoener, 1974). Thus breeding may be timed such that there is an abundant supply of smaller particles for juveniles to feed upon, so that competition between the species would be minimized. Examination of juvenile feeding was beyond the scope of the present study, but it would be of

interest to investigate their diet.

Evidence of diel activity rhythms was obtained from 24-hour sampling sessions conducted at the study site. The results showed that T.sp.2 was less frequent in samples collected in the hours of darkness, but peak abundances were associated with either sunset or sunrise, or both. This may indicate concentration of T.sp.2 prior to night time dispersal and reaggregation as the swarms reform the following morning, similar to the pattern observed by Wittmann (1977). The stomach fullness of T.sp.2 remained high throughout the October 24-hour sampling period, but the proportion of identifiable material was slightly greater at night, especially at 2100hrs, indicating feeding was more intensive in the first few hours after sunset. P.rufa on the other hand, was more frequently caught at night than during the day, but feeding appeared to be greater during the day and early night (2100hrs). The larger numbers of P.rufa caught at night may have been due to the population moving out from the algae where they reside during the day, to the algal/sand interface, which may effectively be a dispersal of daytime swarms. Alternatively, it may have been partially due to their attraction to light (which was used during collection), a behavioural response observed in the laboratory (unpubl. obs.), or due to reduced net avoidance at night (Fleminger and Clutter, 1965). Diel variations in numbers of A.mixta australis could not readily be equated to either tidal or diel rhythms. It is possible that A.mixta australis does not exhibit a regular diel activity rhythm, a feature which, although apparently rare, has been noted for a few species including Leptomysis gracilis and Siriella jaltensis (Mauchline, 1980).

The dispersal of swarms at night has been considered as testimony to the anti-predatory role postulated for swarming in daylight (Wittmann, 1977). However, mating in most littoral mysids apparently takes place at night, the time when swarms disperse and individuals either spread across the sea bottom or migrate vertically upwards (Wittmann, 1984). Until the timing of mating is determined for the species at One Tree Point, it is not possible to fully rationalize the diel activity patterns. However, breeding in the species was asynchronous, so that large breeding swarms at night would not necessarily be expected, because only a small proportion of the female population would be breeding at one time. Although, the 24-hour sampling regime identified changes in species abundance, it did not provide quantified data on the direction of movement within the species populations. To obtain data about the direction of movement, stratified sampling, both horizontally and vertically in relation to the transects, would be required. This was not practicable in the present study.

The differences in resource utilization observed for the mysids may be the result of competitive interactions or may be a response to avoidance or minimization of predation. Two main methods are employed by mysids to reduce predation in bright light: swarming and camouflage (Wittmann, 1977; Mauchline, 1980). Nevertheless, species can be identified at all positions in the spectrum between swarm specialists to substrate specialists, and many exhibit a combination of the two (Wittmann, 1977). T.sp.2, A.mixta australis and P.rufa all swarm, but they also have cryptic colouration which reflects their zone of occurrence, eg. P.rufa is bright orange-red above the algae; A.mixta australis is almost transparent, at the edge of the algae and T.sp.2 is also transparent with small pigmented areas on the ventral surface, when collected on sand. In addition to swarming and camouflage, the co-existence of several species and zonation itself may confer protection upon the species, particularly those closest to shore. Thorp (1976) suggested that the cohabitation of two species of grass shrimp within shoreline areas conferred some protection from predators for both species. Relating this to the mysid situation, the zonation parallel to the rocky shore at the study site therefore may tend to protect the species closest inshore, i.e. P.rufa and A.mixta australis, leaving T.sp.2 more open to predation from outside the algal fringe zone.

Several fish predators, were identified at One Tree Point. Juvenile salmon, Arripis trutta were commonly found with mysids (mainly T.sp.1 and T.sp.2) in their stomachs. Other predators included juvenile yellow-eyed mullet Aldrichetta forsteri, southern cardinalfish Vincentia conspersa and purple wrasse Pseudolabrus fucicola. Additional predators were implicated from isotopic analysis including the common sandfish Crapatalus arenarius, flounder Ammotretis liturata, common weedfish Heteroclinus perspicillatus and the weedy sea-dragon Phyllopteryx taeniolatus. However, in view of the densities of T.sp.2, A.mixta australis and P.rufa present, and their productivity, the numbers observed in the gut contents of fish predators was relatively very small. The three abundant mysids at the study site were less frequent in the guts than T.sp.1, the density of which was much lower in the bay. Whereas T.sp.2, A.mixta australis and P.rufa all swarm and their colouration blends into their habitat, T.sp.1 was rarely observed swarming and its dark colour may have made it easier for predators to detect. It is of course very difficult to obtain realistic estimates of the impact of predation from all sources (eg. fish, invertebrates and birds) in a natural mysid community. A dramatic change in the population size in a relatively short time may frequently be due to the degree of aggregation within the population or maybe related to the production of young; rarely

can it be related to predation (Mauchline, 1971e, 1980).

Although it was possible to obtain evidence of differences in resource utilization by examining naturally occurring mysid populations at One Tree Point, further field and experimental investigations are needed to determine the exact nature of the species relationships in the context of the whole community, i.e. to determine the factors (eg. competition, predation and/or environmental) controlling the distribution, diet and behaviour of the mysids.

In conclusion, the present study had dealt extensively with the taxonomy of Australian mysids including the addition of new numerous records, 3 new genera and 12 new species. Despite the relatively large number of mysid species now known from Australia (n=94), only a small proportion of the coastline has been sampled. It is to be expected that many more records and new additions will be described in the future. Regarding the ecology of mysids in Australian waters, even less is known, so that virtually all aspects of their biology and ecology require investigation.

REFERENCES

Abelson, P.L. and Hoering, T.C. (1961).
Carbon isotope fractionation in formation of amino acids by photosynthetic organisms.
Proc. Natl. Acad. Sci. 47, 623-632.

Allen, D.M. (1984).
Population dynamics of the mysid shrimp Mysidopsis bigelowi (W.M. Tattersall) in a temperate estuary.
J. Crust. Biol. 4, 25-34.

Almeido Prado, M.S. (1973).
Distribution of Mysidacea (Crustacea) in the Cananeia region.
Bol. Zool. Biol. Mar. 30, 395-417.

Amaratunga, T. and Corey, S. (1975).
Life history of Mysis stenolepis Smith (Crustacea, Mysidacea).
Can. J. Zool. 53, 942-952.

Astthorsson, O.S. and Ralph, R. (1984).
Growth and moulting of Neomysis integer (Crustacea: Mysidacea).
Mar. Biol. 79, 55-61.

Attramadal, Y.G. (1981).
On a non-existent ventral filtration current in Hemimysis lamornae (Couch) and Praunus flexuosus (Muller) (Crustacea: Mysidacea).
Sarsia 66, 283-286.

Azeta, M., Ikemoto, R., Sudo, R. and Azuma, M. (1983).
Feeding habits of a cardinal fish Apogon semilineatus in Shijiki Bay (Hirado Island, Nagasaki Pref.) laying stress on relationships to 0-group red seabream (Pagrus major).
Bull. Seikai Reg. Fish. Res. Lab./Seisuiken Kenpo 59, 85-89.

Bacescu, M. (1968a).
Heteromysini nouveaux des eaux Cubaines: trois espèces nouvelles de Heteromysis et Heteromysoides spongicola n.g. n.sp.
Rev. Roum. Biol. Sér. Zool. 13, 221-237.

Bacescu, M. (1968b).
Contributions to the knowledge of the Gastrosaccinae psammobionte of the Tropical America, with the description of a new genus (Bowmaniella n.g.) and three new species of its frame.
Trans. Mus. Hist. Nat. "Gr. Antipa" 8, 355-373.

Bacescu, M. (1971).
Mysimenzies hadalis g.n., sp.n., a benthic mysid of the Peru Trench, found during cruise XI/1965 of R/V Anton Bruun (U.S.A.).
Revue Roumaine de Biologie, Série de Zoologie 16, 3-8.

Bacescu, M. (1973a).
Anisomysis levi n.sp. from the Red Sea and the dichotomic key of the species belonging to the genus with description of a new taxon, Paranisomysis n.sg.
Rev. Roum. Biol. Zool. 18, 173-180.

Bacescu, M. (1973b).
New mysids from the littoral East African waters: Haplostylus estafricana n.sp. and Anisomysis ijimai estafricana n.sp.
Revue Roumaine de Biologie, Série de Zoologie 18, 317-324.

Bacescu, M. (1975).
Contributions to the knowledge of the mysid (Crustacea) from the Tanzanian waters.
Univ. Sci. J. (Dar. Univ) 1, 39-61.

Bacescu, M. (1979).
A small contribution to the knowledge of the mysids from north-eastern Great Barrier Reef of Australia.
Trav. Mus. Hist. Nat. "Grigore Antipa" 20, 143-147.

Bacescu, M. (1983).
New Heteromysini from the coral area near Heron Island (S.E. Queensland)- Australia.
Rev. Roum. Biol.- Biol. Anim., Tome 28, 3-11.

Bacescu, M. and Bruce, A.J. (1980).
New contributions to the knowledge of the representatives of the genus Heteromysis s.l. from the Australian Coral Reefs.
Trav. Mus. Hist. Nat. "Grigore Antipa" 21, 63-72.

Bacescu, M. and Gleye, L.G. (1979).
New Mysidacea from the Californian waters.
Trav. Mus. Hist. Nat."Grigore Antipa" 20, 131-141.

Bacescu, M. and Schiecke, U. (1974).
Gastrosaccus magnilobatus n.sp. and Erythrops peterdohrni n.sp. (Mysidacea) - new surprises from the Mediterranean benthos.
Crustaceana 27, 113-118.

Bacescu, M. and Udrescu, A. (1982).
New contributions to the knowledge of the Mysidacea from Australia.
Trav. Mus. Hist. Nat. "Grigore Antipa" 24, 79-96.

Bacescu, M. and Udrescu, A. (1984).
New data on the mysids from the South-Australian waters. The description of Halemysis australiensis gen.n., sp.n.
Rev. Roum. Biol.-Biol. Anim. Tome. 29, 93-98.

Bacescu, M. and Vasilescu, E. (1973).
New benthic myisds from the littoral waters of Kenya: Mysidopsis kenyana n.sp. and Nouvelia natalensis mombase n.g. n.sp.
Rev. Roum. Biol. Zool. 18, 249-256.

Baines, P.G., Edwards, R.J. and Fandry, C.B. (1983).
Observations of a new Baroclinic current along the western continental slope of Bass Strait.
Aust. J. Mar. Freshw. Res. 34, 155-157.

Banner, A.H. (1948).
A taxonomic study of the Mysidacea and Euphausiacea (Crustacea) of the northeast Pacific. Part II. Mysidacea, from tribe Mysini through subfamily Mysidellinae.
Trans. Roy. Can. Inst. 27, 65-125.

Banner, D.M. and Banner, A.H. (1981).
The Alpheid Shrimp of Australia. Part III. The remaining alpheids, principally the genus Alpheus and the family Ogyridadae.
Rec. Aust. Mus. 34, 1-357.

Barnard, J.L. (1972).
The marine fauna of New Zealand: Algae-living littoral Gammaridae (Crustacea: Amphipoda).
N.Z. DSIR Bull. 210, 1-216.

Bary, B.M. (1956).
Notes on ecology, systematics and development of some Mysidacea and Euphausiacea (Crustacea) from New Zealand.
Pacific Science 10, 431-467.

Beeton, A.M. and Clarke, W.D. (1973).
Mysid bibliography.
Centre for Great Lake studies, the University of Wisconsin-Milwaukee, Special Report No. 16, 1-145.

Bell, J.D., Burchmore, J.J. and Pollard, D.A. (1978).
Feeding ecology of a scorpaenid fish, the fortescue Centropogon australis from a Posidonia seagrass habitat in New South Wales.
Aust. J. of Mar. Freshw. Res. 29, 175-185.

Belyaev, G.M. (1966).
"Hadal Bottom Fauna of the World Ocean", Israel Program for Scientific Translations, Jerusalem, 1972. pp 199.

Benke, A.C. (1979).
A modification of the Hynes method for estimating secondary production with particular significance for multivoltine populations.
Limnol. Oceanogr. 24, 168-171.

Benke, A.C. and Waide, J.B. (1977).
In defense of average cohorts.
Freshwater Biol. 7, 61-63.

Bennett, I. and Pope, E.C. (1953).
Intertidal zonation of the exposed rocky shores of Victoria, together with a rearrangement of the biogeographical provinces of temperate Australian shores.
Aust. J. Mar. Freshw. Res. 4, 105-159.

Bennett, I. and Pope, E.C. (1960).
Intertidal zonation of the exposed rocky shores of Tasmania and its relationship with the rest of Australia.
Aust. J. Mar. Freshw. Res. 11, 182-221.

Birstein, J.A. and Tchindonova, J.G. (1958).
The deep sea mysids of the north west Pacific Ocean.
Trudy Instituta okeanologii, Akademiya nauk SSSR 27, 258-355.

Black, C.C. and Bender, M.M. (1976).
$\delta^{13}C$ values in marine organisms from the Great Barrier Reef.
Aust. J. Plant Physiol. 3, 25-32.

Blackburn, M. (1942).
A systematic list of the Hydroida of South Australia with a summary of their distribution in other seas.
Trans. Roy. Soc. S. Aust. 66, 104-118.

Bowers, J.A. and Grossnickle, N.E. (1978).
The herbivorous habits of Mysis relicta in Lake Michigan.
Limnol. Oceanogr. 23, 767-776.

Bowers, J.A. and Vanderploeg, H.A. (1982).
In situ predatory behaviour of Mysis relicta.
Hydrobiologia 93, 121-131.

Brattegard, T. (1973).
Mysidacea from shallow water on the Caribbean coast of Colombia.
Sarsia 54, 1-66.

Brattegard, T. (1980).
Platymysis facilis gen. et sp. nov. (Crustacea: Mysidacea: Heteromysini) from the Saba Bank, Caribbean Sea.
Sarsia 65, 49-52.

Bremer, P. and Vijverberg, J. (1982).
Production, population biology and diet of Neomysis integer (Leach) in a shallow Frisian Lake (The Netherlands).
Hydrobiologia 93, 41-51.

Briggs, J.C. (1974).
"Marine Zoogeography".
McGraw-Hill, U.S.A.

Brown, A.C. and Talbot, M.S. (1972).
The ecology of sandy beaches of the Cape Peninsula, South Africa. Part 3. A study of Gastrosaccus psammodytes Tattersall (Crustacea: Mysidacea).
Trans. Roy. Soc. S. Africa 40, 309-333.

Buchanan, J.B. and Kain, J.M. (1971).
Measurement of the physical and chemical environment.
In: **"Methods for the Study of Marine Benthos"**, (Holme, N.A. & McIntyre, A.D, eds.), (IBP Handbook No. 16), pp 30-58.
Blackwell Sci., Oxford and Edinburgh.

Byers, S.C., Mills, E.L. and Stewart, P.L. (1978).
A comparison of methods of determining organic carbon in marine sediments, with suggestions for a standard method.
Hydrobiologia 58, 43-47.

Calman, W.T. (1904).
On the classification of the Crustacea Malacostraca.
Ann. Mag. Nat. Hist., Ser. 7. 13, 144-158.

Cannon, H.G. and Manton, S.M. (1927).
On feeding mechanisms of a mysid crustacean Hemimysis larmornae.
Trans. Roy. Soc., Edinburgh 55, 219-254.

Carpenter, G.F., Mansey, E.L. and Watson, N.H.E. (1974).
Abundance and life history of Mysis relicta in the St. Lawrence Great Lakes.
J. Fish. Res. Bd. Can. 31, 319-325.

Childress, J.J. and Price, M.H. (1978).
Growth rate of the Bathypelagic crustacean Gnathophausia ingens (Mysidacea: Lophogastridae). 1. Dimensional growth and population structure.
Mar. Biol. 50, 47-62.

Chilton, C. (1926).
The New Zealand crustacea Euphausiacea and Mysidacea.
Trans. Proc. New Zealand Inst. 56, 519-522.

Clarke, H.L. (1946).
The Echinoderm fauna of Australia, its composition and its origin.
Publs. Carnegie Inst. No. 566

Clarke, W.D. (1961).
A giant specimen of Gnathophausia ingens (Dohrn, 1870) (Mysidacea) and remarks on the asymmetry of the paragnaths in the suborder Lophogastrida.
Crustaceana 2, 313-324.

Clutter, R.I. (1967).
Zonation of nearshore mysids.
Ecology 48, 200-208.

Clutter, R.I. (1969).
The microdistribution and social behaviour of some pelagic mysid shrimps.
J. Exp. Mar. Biol. Ecol. 3, 125-155.

Clutter, R.I. and Theilacker, G.H. (1971).
Ecological efficiency of a pelagic mysid shrimp; estimates from growth, energy budget and mortality studies.
Fish. Bull. U.S. 69, 93-115.

Coifmann, I. (1936).
Alcuni misidacei nuovi raccolti dal Prof. L. Sanzo nella crociera della R.N. Ammiraglio Magnaghi al Mar Rosso (1923-1924).
Boll. Zool. Napoli 7, 83-88.

Coifmann, I. (1937).
I misidacei del Mar Rosso. Studio del materiale raccolte dal Prof. L. Sanzo durante la campagne idrografica della R. Nave Ammiraglio Magnaghi (1923-1924).
Mem. R. Comitato Talassografico Ital. 233, 1-52.

Colosi, G. (1919).
Nota preliminaire sui misidacei raccolti dalla R.N. "Liguria" nel 1903-1905.
Bull. Soc. Ent. Italiana 49, 3-11.

Colosi, G. (1920).
Crostaei. Part IV. Mysidacei.
Raccolte planctoniche fatte dalla R. Nave "Liguria" 2, 1-260.

Colosi, G. (1924).
Euphausiacea e misidacea raccolti dalla R. Nave "Vettor Pisani" nel 1882-1885.
Ann. Mus. Zool. Univ. Napoli, new Ser. 5, 1-7.

Connell, A.D. (1974).
Mysidacea of the Mtentu River Estuary, Transkei, South Africa.
Zoologica Africana 9, 147-159.

Connell, J.H. (1975).
Some mechanisms producing structure in natural communities: a model and evidence from field experiments.
In: **"Ecology and Evolution of Communities"**, pp 460-490.
(Cody, M.L. & Diamond, J.M., eds.)
Belknap Press, Cambridge, Massachusetts, USA.

Cooper, S.D. and Goldman, C.R. (1980).
Opossum shrimps (Mysis relicta) predation on zooplankton.
Can. J. Fish. Aquat. Sci. 37, 909-919.

Cooper, S.D. and Goldman, C.R. (1982).
Environmental factors affecting predation rates of Mysis relicta.
Can. J. Fish. Aquat. Sci. 39, 203-208.

Crawford, C. (1984).
"An Ecological Study of Tasmanian Flounder", unpublished Ph.D. thesis, University of Tasmania.

Cresswell, G.R. and Golding, T.J. (1980).
Observations of a south-flowing current in the south-eastern Indian Ocean.
Deep Sea Res. 27, 449-466.

Cushman, R.M., Shugart, H.H.J., Hilderbrand, S.G. and Elwood, J.W. (1978).
The effect of growth curve and sampling regime in instantaneous-growth, removal-summation, and Hynes/Hamilton estimates of aquatic insect production: A computer simulation.
Limnol. Oceanogr. 23, 184-189.

Dadswell, M.J. (1975).
Some notes on shoaling behaviour and growth of Mysis gaspensis in a small Newfoundland estuary.
Can. J. Zool. 53, 374-377.

Dakin, W.J. and Colefax, A.N. (1940).
The plankton of the Australasian coastal waters off New South Wales. Part 1.
Publications of the University of Sydney, Department of Zoology, Monograph 1, 1-215.

Dana, J.D. (1850).
Synopsis generum crustaceorum ordinis "Schizopoda".
Amer. J. Sci. Arts 9, 129-133.

Dana, J.D. (1852-1855).
Crustacea. Part 1.
In: **"Wilkes, Charles (commander), United States Exploring Expedition during the years 1838-1842. Volume 13"**, pp 1-685.
C. Sherman, Philadelphia.

Dartnall, A.J. (1974).
Littoral biogeography.
In: **"Biogeography and Ecology in Tasmania"**, (W.D. Williams, ed.), pp 171-194.
Dr. W. Junk Publishers, Hague, Netherlands.

Delsman, H.C. (1939).
Preliminary plankton investigations in the Java Sea.
Treubia 17, 139-181.

DeNiro, M.J. and Epstein, S. (1978).
Influence of diet on the distribution of carbon isotopes in animals.
Geochim. Cosmochim. Acta. 42, 495-506.

Dessaix, J. and Roux, A.L. (1980).
Structure and dynamics of the French upper Rhône ecosystems. X. An estimate of the secondary production of Gammarids in the main stream.
Crustaceana suppl. 6, 242-252.

Dohrn, A. (1870).
Untersuchungen uber Bau und Entwicklung der Arthropoden. 10. Beitraege zur Kenntnis der Malacostraken und ihrer Larven.
Zeitschr. Wiss. Zool. 20, 607-625.

Doutch, H.F. (1972).
The paleogeography of northern Australia and New Guinea and its relevance to the Torres Strait area.
In: **"Bridge and Barrier: The Natural and Cultural History of Torres Strait"**, (D. Walker, ed.).
Research School of Pacific Studies, Dept. of Biogeography and Geomorphology, Australian National University.

Edgar, G.J. (1984).
General features of the ecology and biogeography of Tasmanian subtidal rocky shore communities.
Pap. Proc. Roy. Soc. Tas. 118, 173-186.

Ekman, S. (1967).
"Zoogeography of the Sea", (translated by E. Palmer from original published in 1953).
Sidgwick and Jackson, London.

Emery, A.R. (1968).
Preliminary observations on coral reef plankton.
Limnol. Oceanogr. 13, 293-303.

Endean, R. (1957).
The biogeography of Queensland's shallow water echinoderm fauna (excluding Crinoidea) with a rearrangement of the faunistic provinces of tropical Australia.
Aust. J. Mar. Freshw. Res. 8, 233-273.

Endean, R., Kenny, R. and Stephenson, W. (1956).
The ecology and distribution of intertidal organisms of the rocky shores of the Queensland mainland.
Aust. J. Mar. Freshw. Res. 7, 88-146.

Estep, M.F. and Dabrowski, H. (1980).
Tracing food webs with stable hydrogen isotopes.
Science 209, 1537-1538.

Estep, M.F. and Hoering, T.C. (1980).
Biogeochemistry of the stable hydrogen isotopes.
Geochim. Cosmochim. Acta. 44, 1197-1206.

Fage, L. (1941).
Mysidacea, Lophogastrida I.
Dana Reports 4, 1-52.

Fager, E.W. and Clutter, R.I. (1968).
Parameters of a natural population of hypopelagic marine mysid, Metamysidopsis elongata (Holmes).
Physiol. Zool. 41, 257-267.

Fenton, G.E. (1981).
"Production and Trophic Relations of Nyctiphanes australis G.O. Sars 1883 (Euphausiacea) in the coastal waters of South-East Tasmania".
Unpublished Hons. Thesis, University of Tasmania.

Fenton, G.E. (1985a).
Description of Paramesopodopsis rufa n.g. n.sp. from the coastal waters of southern Tasmania.
Hydrobiologia 122, 171-174.

Fenton, G.E. (1985b).
Tasmanomysis oculata n.g. n.sp. from Tasmanian waters (Crustacea: Mysidacea: Mysini).
Hydrobiologia (in press).

Fleminger, A. and Clutter, R.I. (1965).
Avoidance of towed nets by zooplankton.
Limnol. Oceanogr. 10, 96-104.

Folt, C.L., Rybock, J.T. and Goldman, C.R. (1982).
The effect of prey composition and abundance on the predation rate and selectivity of Mysis relicta.
Hydrobiologia 93, 133-143.

Foulds, J.B. and Mann, K.H. (1978).
Cellulose digestion in Mysis stenolepis and its ecological implications.
Limnol. Oceanogr. 23, 760-766.

Friedman, I. (1953).
Deuterium content of natural waters and other substances.
Geochim. Cosmochim. Acta 44, 1197-1206.

Froelich, P.N. (1980).
Analysis of organic carbon in marine sediments.
Limnol. Oceanogr. 25, 564-572.

Fry, B. and Parker, P.L. (1979).
Animal diet in Texas seagrass meadows: ^{13}C evidence for the importance of benthic plants.
Estuar. Coast Mar. Sci. 8, 499-509.

Fry, B., Joern, A. and Parker, P.L. (1978).
Grasshopper food web analysis: use of carbon isotope ratios to examine feeding relationships among terrestrial herbivores.
Ecology 59, 498-506.

Fry, B., Lutes, R., Northam, M. and Parker, P.L. (1982).
A $^{13}C/^{12}C$ comparison of food webs in Caribbean seagrass meadows and coral reefs.
Aquat. Bot. 14, 389-398.

Fry, B., Scalan, R.S. and Parker, P.L. (1983).
$^{13}C/^{12}C$ ratios in marine food webs of the Torres Strait, Queensland.
Aust. J. Mar. Freshw. Res. 34, 707-715.

Fulton, R.S. III. (1982a).
Preliminary results of an experimental study of the effects of mysid predation on estuarine zooplankton community structure.
Hydrobiologia 93, 79-84.

Fulton, R.S. III. (1982b).
Predatory feeding of two marine mysids.
Mar. Biol. 72, 183-191.

Gaudy, R. and Guerin, J.P. (1979).
Ecophysidogie comparée des mysidaces Hemimysis speluncola Ledoyer (cavernicole) et Leptomysis lingvura G.O. Sars (non cavernicole). Action de la température sur la croissance en élevage.
J. Exp. Mar. Biol. Ecol. 38, 101-109.

Gentilli, J. (1972).
Thermal anomalies of the eastern Indian Ocean.
Nature Lond. Physical Sciences 238, 93-95.

Goodbody, I. (1965).
Continuous breeding in populations of two tropical crustaceans, Mysidium columbiae (Zimmer) and Emerita portoricensis Schmidt.
Ecology 46, 195-197.

Gordan, J. (1957).
A bibliography of the Order Mysidacea.
Bull. Amer. Mus. Nat. Hist. 112, 279-394.

Grabe, S.A. and Hatch, E.R. (1982).
Aspects of the biology of Mysis mixta (Lilljeborg 1852) (Crustacea, Mysidacea) in New Hampshire coastal waters.
Can. J. Zool. 60, 1275-1281.

Greenwood, J.G. and Hadley, D.J. (1982).
A redescription of the mysid Idiomysis inermis Tattersall 1922 MYSIDACEA to include the previously unknown female.
Crustaceana 42, 174-193.

Griffin, D.J.C. and Yaldwyn, J.C. (1968).
The constitution, distribution and relationships of the Australian decapod crustacea.
Proc. Linn. Soc. N.S.W. 93, 164-183.

Grossnickle, N.E. (1982).
Feeding habits of Mysis relicta - an overview.
Hydrobiologia 93, 101-107.

Haines, E.B. (1976).
Stable carbon isotope ratios in the biota, soils and tidal water of a Georgia salt marsh.
Estuar. Coast Mar. Sci. 4, 609-616.

Haines, E.B. and Montague, C.L. (1979).
Food sources of estuarine invertebrates analyzed using $^{13}C/^{12}C$ ratios.
Ecology 60, 48-56.

Hakala, I. (1978).
Distribution, population dynamics and production of Mysis relicta (Lovén) in southern Finland.
Annales Zool. Fenn. 15, 243-258.

Hale, H.M. (1929).
"The Crustaceans of South Australia. Pt. II.", pp 201-380.
Harrison Weir, Adelaide.

Hamilton, A.L. (1969).
On estimating annual production.
Limnol. Oceanogr. 14, 771-782.

Haney, J.F. and Hall, D.J. (1973).
Sugar-coated Daphnia: a preservation technique for Cladocera.
Limnol. Oceanogr. 18, 331-333.

Hansen, H.J. (1893).
Zur Morphologie der Gliedmassen und Mundteile by Crustacean und Insekten.
Zool. Anz. 16, 201-212.

Hansen, H.J. (1910).
The Schizopoda of the Siboga Expedition.
Siboga Expedition 37, 1-120.

Hansen, H.J. (1912).
Reports on the scientific results of the expedition to the eastern tropical Pacific, in charge of Alexander Agissaz, by the U.S. Fish Commission Steamer "Albatross" from October 1904 to March 1905. Lieut.-Commander L.M. Garett U.S.N. commanding 27. The Schizopoda.
Mem. Mus. Comp. Zool. Harv. 35, 175-296.

Hardin, G. (1960).
The competitive exclusion principle.
Science 131, 1292-1297.

Hargrave, B.T. (1970).
The utilization of benthic microflora by Hyalella azteca (Amphipoda).
J. Anim. Ecol. 39, 427-437.

Hatzakis, A. (1977).
Contribution a l'etude des Gastrosaccinae (Crustacea: Mysidacea) de la Mediterranee: Description de Haplostylus bacescui n.sp. et revision de la nomenclature des Haplostylus et Gastrosaccus Mediterraneens.
Biologia Gallo-Hellenica 6, 271-287.

Herman, S.S. (1963).
Vertical migration of the opossum shrimp Neomysis americana Smith.
Limnol. Oceanogr. 8, 228-238.

Heubach, W. (1969).
Neomysis awatschensis in the Sacramento-San Joaquin estuary.
Limnol. Oceanogr. 14, 533-546.

Hines, A.H. (1982).
Coexistence in a kelp forest: size, population dynamics, and resource partitioning in a guild of spider crabs (Brachyura, Majidae).
Ecol. Monogr. 52, 179-198.

Hirota, J. and Szyper, J.P. (1975).
Separation of total particulate carbon into organic components.
Limnol. Oceanogr. 20, 896-900.

Hobson, E.S. and Chess, J.R. (1976).
Trophic interactions among fishes and zooplankters near shore at Santa Catalina Island, California.
Fish. Bull. U.S. 74, 567-598.

Hobson, E.S. and Chess, J.R. (1978).
Trophic relationships among fishes and plankton in the lagoon of Enewetak Atoll, Marshall Islands.
Fish. Bull. U.S. 76, 133-153.

Hodge, D. (1963a).
A new species of mysid (Mysidacea: Crustacea) from the Brisbane River.
Univ. Queensland Pap. Zool. 2, 83-88.

Hodge, D. (1963b).
The distribution and ecology of mysids in the Brisbane River.
Univ. Queensland Pap. Zool. 11, 89-104.

Hodge, D. (1964).
A redescription of Tenagomysis chiltoni (Crustacea:Mysidacea) from a freshwater coastal lake in New Zealand.
New Zealand J. Sci. 7, 387-395.

Holt, E.W.L. and Tattersall, W.M. (1905).
Schizopodous Crustacea from the North-East Atlantic Slope.
Ann. Rep. Fish. Ireland, 1902-1903, pt. 2, 99-151.

Holt, E.W.L. and Tattersall, W.M. (1906).
Preliminary notice of the Schizopoda collected by H.M.S. "Discovery" in the Antarctic region.
Ann. Mag. Nat. Hist., Ser. 7 17, 1-11.

Hopkins, T.L. (1965).
Mysid shrimp abundance in surface waters of Indian River Inlet, Delaware.
Chesapeake Sci. 6, 86-91.

Hosie, G.W. (1982).
"Biology and Production of Nyctiphanes australis G.O. Sars, in the coastal waters of S.E. Tasmania", unpublished, M.Sc., University of Tasmania.

Houston, T.F. (1979).
Sea turtles in South Australia.
S. Aust. Nat. 53, 42-46.

Hutchinson, G.E. (1959).
Homage to Santa Rosalia or why are there so many kinds of animals?
American Naturalist 93, 145-159.

Hutchinson, G.E. (1961).
The paradox of plankton.
American Naturalist 95, 137-145.

Hynes, H.B.N. (1980).
A name change in the secondary production business.
Limnol. Oceanogr. 25, 778.

Hyslop, E.J. (1980).
Stomach contents analysis - a review of methods and their application.
J. Fish. Biol. 17, 411-429.

Ii, N. (1937).
Studies on Japanese Mysidacea III: Descriptions of four new species belonging to tribes Leptomysini and Erythropini.
Jap. J. Zool. 7, 191-209.

Ii, N. (1964).
Fauna Japonica, Mysidae.
Biogeogr. Soc. Japan, 610

Illig, G. (1906).
Bericht uber die neun Schizopoden-gattungen und-arten der Deutschen Tiefsee Expedition 1898-1899.
Zool. Anz. 30, 194-211.

Illig, G. (1908).
Ein weiterer Bericht über die Mysideen der Deutschen Tiefsee-Expedition 1898-1899.
Zool. Anz. 32, 550-551.

Illig, G. (1930).
Die Schizopoden der deutschen Tiefsee-Expedition.
Rep. Valdivae. Exped. 22, 397-625.

Ishikawa, M. and Oshima, Y. (1951).
On the life history of a mysid crustacean, Neomysis japonica Nakazawa.
Bull. Jap. Soc. Scientific Fisheries 16, 461-477.

Jepsen, J. (1965).
Marsupial development of Boreomysis arctica (Kroyer, 1861).
Sarsia 20, 1-8.

Johnston, N.T. and Lasenby, D.C. (1982).
Diet and feeding of Neomysis mercedis Holmes (Crustacea, Mysidacea) from the Fraser River Estuary, British Columbia.
Can. J. Zool. 60, 813-824.

Kensley, B. (1983).
Biogeographical relationships of some southern African benthic crustacea.
Mem. Aust. Mus. - papers from the conference on the biology and evolution of crustacea - held at the Aust. Mus., 1980; J.K. Lowry. 18, 173-181.

Kislalioglu, M. and Gibson, R.N. (1976).
Some factors governing prey selection by the 15-spined stickleback Spinachia spinachia (L).
J. Exp. Mar. Biol. Ecol. 25, 159-169.

Klumpp, D.W. and Nichols, P.D. (1983).
A study of food chains in seagrass communities II. Food of the rock flathead Platycephalus laevigatus Cuvier, a major predator in a Posidonia australis seagrass bed.
Aust. J. Mar. Freshw. Res. 34, 745-754.

Knox, G.A. (1963).
The biogeography and intertidal ecology of the Australian coasts.
Oceanogr. Mar. Biol. Ann. Rev. 1, 341-403.

Kossmann, R. (1880).
Malacostraca, (2 Theil Anditura), Zoologische Ergebnisse einer Reise in die Kusten Gebietere des Rothen Meeres.
Leipzig, Wilhelm Engelmann 2, 67-140.

Kost, A.L.B. and Knight, A.W. (1975).
The food of Neomysis mercedis Holmes in the Sacramento-San Joaquin Estuary.
Calif. Fish & Game 61, 35-46.

Kott, P. (1953).
Modified whirling apparatus for the sub-sampling of plankton.
Aust. J. Mar. Freshw. Res. 4, 387-393.

Kroyer, H.N. (1861).
Et bidrag til Kundskab om Krebsdyrfamilien Mysidea.
Naturhist. Tidsskr., Copenhagen, Ser. 3 1, 1-75.

Krueger, C.C. and Martin, F.B. (1980).
Computation of confidence intervals for the size-frequency (Hynes) method of estimating secondary production.
Limnol. Oceanogr. 25, 773-777.

Lagardere, J-P. and Nouvel, H. (1980).
Mysidacea from the Bay of Biscay continental slope 2. Lophogastridae, Eucopiidae and Mysidae families (except the Erythropini tribe).
Bull. Mus. Natl. Hist. Nat. Ser. A Zool. 2, 375-412.

Lasenby, D.C. and Langford, R.R. (1972).
Growth, life history and respiration of Mysis relicta in an arctic and temperate lake.
J. Fish. Res. Bd. Can. 29, 1701-1708.

Last, P.R. (1983).
"Ecology and Zoogeography of Tasmanian Shore Fishes", unpublished Ph.D. thesis, University of Tasmania.

Last, P.R., Scott, E.O.G. and Talbot, F.H. (1983).
"Fishes of Tasmania".
Tasmanian Fisheries Development Authority, Government Printer Tasmania.

LaTouche, R.W. (1978).
The feeding behaviour of the featherstar Antidon bifida (Echinodermata: Crinoidea).
J. Mar. Biol. Ass. U.K. 58, 877-890.

Latreille, P.A. (1803).
Histoire naturelle, génerale et particulière des crustacés et des insectes.
Paris F. Dufart 6, 1-391.

Latreille, P.A. (1817).
Les crustacés, les arachnides et les insectes.
In: "Cuvier, Le règne amimal", Paris, Vol.3, pp 1-75.

LeBrasseur, R.I. and Stephens, K. (1965).
Relative rates of degradation of some organisms consumed by marine salmon.
J. Fish. Res. Bd. Can. 22, 1563-1564.

Lenz, J. (1977).
On detritus as a food source for pelagic filter-feeders.
Mar. Biol. 41, 39-48.

MacArthur, R.H. (1972).
"Geographical Ecology".
Harper & Row, New York, USA.

Macko, S.A., Estep, M.L.F. and Lee, W.Y. (1983).
Stable hydrogen isotope analysis of foodwebs on laboratory and field populations of marine amphipods.
J. Exp. Mar. Biol. Ecol. 72, 243-249.

Macquart-Moulin, C. (1972).
Modifications des réactions photocinétiques des Pericarides de l'hyponeuston nocturne en fonction de l'importance de l'eclairement.
Tethys 3, 897-920.

Macquart-Moulin, C. (1973).
L'activité natatoire rhythmique chez les peracarides benthoplanktonques. Determinisme endogène des rhythmes nycthemeraux.
Tethys 5, 209-231.

Macquart-Moulin, C. (1977a).
Le controle de l'emergence et des nages nocturnes chez les peracarides des plages de Méditerranée, Eurydice affinis Hansen (Isopoda), Gastrosaccus mediterraneus Bacescu, Gastrosaccus spinifer (Goes) (Mysidacea).
J. Exp. Mar. Biol. Ecol. 27, 61-81.

Macquart-Moulin, C. (1977b).
Les réactions photocinetiques des peracarides du plankton nocturne. Fraction planktonique: Gastrosaccus lobatus et Gastrosaccus armatus.
Tethys 7, 339-348.

Mann, K.H. (1972).
Macrophyte production and detritus food chains in coastal waters.
In: "Detritus and its Role in Aquatic Ecosystems", vol. 29, Supplement 13-16, Pallanzo, (Melchioni-Santalini, U. and Hopton, J., eds.), pp 325-352.
Memoire Dell'Instito Italiano di Idrobiologia (Proceedings of an IBP-UNESCO Symposium).

Mann, K.H. (1982).
"Ecology of Coastal Waters: A Systems Approach", pp 1-332.
Blackwell Scientific Publications, Oxford, Great Britain.

Manton, S.M. (1928).
On the embryology of a mysid, crustacean Hemimysis larmornae.
Philos. Trans. Royal Soc. Ser. B 216, 363-463.

Markina, N.P. (1976).
Biogeographic structure of the Pelagic Zone in the Southern Hemisphere.
Oceanology 15, 366-367.

Marshall, A.J. and Williams, W.D. (1975).
"Textbook of Zoology Invertebrates", 7th. edition, pp 874.
MacMillan Press, London.

Mather, K. (1973).
"Statistical Analysis in Biology".
Chapman and Hall Ltd., Great Britain.

Mauchline, J. (1965).
Breeding and fecundity of Praunus inermis (Crustacea: Mysidacea).
J. Mar. Biol. Ass. U.K. 45, 663-671.

Mauchline, J. (1967).
The biology of Schistomysis spiritus (Crustacea; Mysidacea).
J. Mar. Biol. Ass. U.K. 47, 383-396.

Mauchline, J. (1969).
The biology of Leptomysis gracilis and L.lingvura [Crustacea, Mysidacea].
J. Mar. Biol. Ass. U.K. 49, 379-389.

Mauchline, J. (1970a).
The biology of Schistomysis ornata (Crustacea, Mysidacea).
J. Mar. Biol. Ass. U.K. 50, 169-175.

Mauchline, J. (1970b).
The biology of Mysidopsis gibbosa, M.didelphys and M.angusta (Crustacea; Mysidacea).
J. Mar. Biol. Ass. U.K. 50, 381-396.

Mauchline, J. (1971a).
The biology of Paramysis arenosa (Crustacea; Mysidacea).
J. Mar. Biol. Ass. U.K. 51, 339-345.

Mauchline, J. (1971b).
The biology of Neomysis integer (Crustacea; Mysidacea).
J. Mar. Biol. Ass. U.K. 51, 347-354.

Mauchline, J. (1971c).
The biology of Praunus flexuosus and P.neglectus (Crustacea; Mysidacea).
J. Mar. Biol. Ass. U.K. 51, 641-652.

Mauchline, J. (1971d).
The biology of Schistomysis kervillei (Crustacea; Mysidacea).
J. Mar. Biol. Ass. U.K. 51, 653-658.

Mauchline, J. (1971e).
Seasonal occurrence of mysids (Crustacea) and evidence of social behaviour.
J. Mar. Biol. Ass. U.K. 51, 809-825.

Mauchline, J. (1973a).
Inter-moult growth of species of Mysidacea (Crustacea).
J. Mar. Biol. Ass. U.K. 53, 569-572.

Mauchline, J. (1973b).
The broods of the British Mysidacea.
J. Mar. Biol. Ass. U.K. 53, 801-817.

Mauchline, J. (1976).
The Hiatt growth diagram for Crustacea.
Mar. Biol. 35, 79-84.

Mauchline, J. (1977).
Estimating production of midwater organisms.
In: "Oceanic Sound Scattering Prediction", (Anderson, N.R. and Zahuranec, B.J. eds.).
Plenum Press.

Mauchline, J. (1980).
The biology of Mysids.
Adv. Mar. Biol. 18, 3-373.

Mauchline, J. and Fisher, L.R. (1969).
The biology of Euphausiids.
Adv. Mar. Biol. 7, 1-454.

Mauchline, J. and Murano, M. (1977).
World list of the Mysidacea, Crustacea.
J. Tokyo Univ. of Fish. 64, 39-88.

Maurer, D. and Wigley, R.L. (1982).
Distribution and ecology of mysids in Cape Cod Bay, Massachusetts.
Biol. Bull. 163, 477-491.

Maxwell, J.G.H. and Cresswell, G.R. (1981).
Dispersal of tropical marine fauna to the Great Australian Bight by the Leeuwin Current.
Aust. J. Mar. Freshw. Res. 32, 493-500.

McConnaughey, T. and McRoy, C.P. (1979a).
Food-web structure and fractionation of carbon isotopes in the Bering Sea.
Mar. Biol. 53, 257-262.

McConnaughey, T. and McRoy, C.P. (1979b).
^{13}C Label identifies eelgrass (Zostera marina) carbon in an Alaskan estuarine food web.
Mar. Biol. 53, 263-269.

McMillan, C., Parker, P.L. and Fry, B. (1980).
$^{13}C/^{12}C$ ratios in seagrasses.
Aquat. Bot. 9, 237-249.

McWilliam, P.S. and Phillips, B.F. (1983).
Study of phyllosoma larvae and other crustacean macrozooplankton associated with eddy J, a warm core-eddy off south-eastern Australia.
Aust. J. Mar. Freshw. Res. 34, 653-664.

Menge, B. and Sutherland, J. (1976).
Species diversity gradients: synthesis of the roles of predation, competition, and heterogeneity.
American Naturalist 110, 351-369.

Menzie, C.A. (1980).
A note on the Hynes method of estimating secondary production.
Limnol. Oceanogr. 25, 770-773.

Milne-Edwards, H. (1830).
Mémoire sur une disposition particulière de l'appareil branchial chez quelques Crustacés.
Annls. Sci. Nat. 19, 451-460.

Milne-Edwards, H. (1837).
Histoire naturelle des crustacés.
Paris, Roret 2, 1-531.

Miroshnichenko, M.P. and Vovk, F.I. (1973).
A model of the Mysidae production process, as exemplified with Paramysis intermedia (Czern) of Tsimlyanskoye Reservoir.
Gidrobiologicheskii Zhurnal 9, 36-44.

Modlin, R.F. (1984).
Mysidacea from the Florida Middle Ground, Northeast Gulf of Mexico, with descriptions of three new species of Heteromysis and a key to the Heteromysini of the Western Atlantic.
J. Crust. Biol. 4, 278-297.

Moran, S. (1972).
Ecology and distribution of the sand-dwelling mysid Gastrosaccus sanctus (Van Beneden, 1861) along the Mediterranean sandy shore of Israel.
Crustaceana suppl. 3, 357-361.

Morgan, M.D. (1982).
Ecology of the Mysidacea.
Hydrobiologia 93, 1-222.

Morgan, M.D. and Beeton, A.M. (1978).
Life history and abundance of Mysis relicta in Lake Michigan.
J. Fish: Res. Bd. Can. 35, 1165-1170.

Morgans, J.F.C. (1956).
Notes on the analysis of shallow-water soft substrata.
J. Anim. Ecol. 24, 367-387.

Müller, O.F. (1776).
"Zoologiae Danicae prodromus, seu animalium Daniae et Norvegiae indigenarum: characteres, nomina, et synomyma imprimus popularium", pp 1-274.
Copenhagen.

Murano, M. (1970).
A small collection of benthic Mysidacea from coastal waters in Suruga Bay, Japan.
Crustaceana 18, 251-268.

Murano, M. (1977).
Mysidacea from the central and western Pacific. IV. Genera Euchaetomera, Euchaetomeropsis, Arachnomysis, Caesaromysis, Echinomysides, Meterythrops and Nipponerythrops (Tribe Erythropini).
Publ. Seto Mar. Biol. Lab. 24, 141-192.

Murano, M. (1981).
Mysidacea from the central and western Pacific. V. Genera Heterorythrops, Meierythrops, Pleurerythrops, Gibberythrops, Illigiella, Dactylamblyops, Pseudoamblyops, Paramblyops, Dactylerythrops and Nakazawaia (Tribe Erythropini).
Publ. Seto Mar. Biol. Lab. 26, 261-302.

Murtaugh, P.A. (1981).
Size-selective predation on Daphnia by Neomysis mercedis.
Ecology 62, 894-900.

Murtaugh, P.A. (1984).
Variable gut residence time: problems in inferring feeding rate from stomach fullness of a mysid crustacean.
Can. J. Fish. Aquat. Sci. 41, 1287-1293.

Nair, K.B. (1939).
The reproduction, oogenesis and development of Mesopodopsis orientalis.
Proc. Ind. Acad. Sci. 9, 175-223.

Nakazawa, K. (1910).
Notes of Japanese Schizopoda.
Annot. Zool. Japonensis 7, 247-261.

Nilsson C.S. and Cresswell, G.R. (1981).
The formation and evolution of east Australian current warm-core eddies.
Prog. Oceanogr. 9, 133-183.

Norman, A.M. (1868).
Preliminary report on the Crustacea, Mollusoida, Echinodermata, and Coelenterata, procured by the Shetland dredging committee in 1867.
Rept. Brit. Assoc. Adv. Sci., 1867 37, 437-441.

Norman, A.M. and Scott, T. (1906).
Mysidacea.
In: "The Crustacea of Devon and Cornwall", pp 23-28.
William Wesley and Son, London.

Nouvel, H. (1942).
Diagnoses preliminaires de Mysidaces nouveaux provenant des Campagnes du Prince Albert I de Monaco.
Bull. Inst. Oceanogr. Monaco 831, 1-12.

Nouvel, H. (1951).
Gastrosaccus normani G.O. Sars 1877 et Gastrosaccus lobatus n.sp. (Crustacea, Mysidacea) avec précision de l'hôte Prodajus lobiancoi Bonnier (Crustacea, Isopoda, Epicar).
Bull. Inst. Oceanogr. Monaco 993, 1-12.

Nouvel, H. (1966).
Les generes Tenagomysis Thomson 1900, Doxomysis Hansen 1912, Afromysis 1916 et Iimysis n.gen. (Crust. Mysidacea Leptomysini).
Bull. Soc. Hist. Nat. Toulouse 102, 319-324.

Nyan, Taw (1975).
"Studies on the Zooplankton and Hydrology of the South-eastern Coastal Waters of Tasmania", unpublished Ph.D. thesis, University of Tasmania.

O'Brien, D.P. - in press
A new species of Mysidetes (Mysidacea, Leptomysini) from marine caves in Tasmania.
Crustaceana (in press).

Omori, M. (1978).
Zooplankton fisheries of the world: A review.
Mar. Biol. 48, 199-205.

Ortmann, A.E. (1905).
Schizopods of the Hawaiin Islands collected by the steamer Albatross in 1902.
Bull. U.S. Fish Comm. 1903 pt.3, 961-973.

Ortmann, A.E. (1906).
Schizopod crustaceans in the U.S. National Museum, The families Lophogastridae and Eucopiidae.
Proc. U.S. Natl. Mus. 31, 23-54.

Panampunnayil, S.U. (1977).
Three new species of Mysidacea from Kerala coast.
In: "Proceedings of the Symposium on Warm Water Zooplankton", Special Publication of National Institute of Oceanography, Goa, India, pp 28-35.

Panampunnayil, S.U. (1982).
Description of a new species of Petalopthalmus (Mysidacea) with a revised definition of the genus.
J. Plank. Res. 4, 643-650.

Panampunnayil, S.U. (1984).
Two new species belonging to the genus Anisomysis (Crustacea, Mysidacea) and a record of Anisomysis bipartoculata from the Indian Ocean.
J. Plank. Res. 6, 943-952.

Park, R. and Epstein, S. (1961).
Metabolic fractionation of ^{13}C and ^{12}C in plants.
Plant Physiol. 36, 133-138.

Parker, P.L., Behrens, E.W., Calder, J.A. and Shultz, D. (1972).
Stable carbon isotope ratio variations in the organic carbon from gulf of Mexico sediments.
Contrib. Mar. Sci. 16, 139-148.

Pechen-Finenko, G.A. and Pavlovskaya, T.V. (1975).
Comparative importance of detritus and algae in the food of Neomysis mirablis.
Hydrobiological J. 11, 28-32.

Peterson, B.J., Howarth, R.W., Lipschultz, F. and Ashendorf, D. (1980).
Salt marsh detritus: an alternative interpretation of stable carbon isotope ratios and the fate of Spartina alterniflora.
Oikos 34, 173-177.

Peterson B.J., Howarth, R.W. and Garritt, R.H. (1985).
Multiple stable isotopes used to trace the flow of organic matter in estuarine food webs.
Science 227, 1361-1363.

Petrovich, P.G., Shushkina, E.A. and Pechen, G.A. (1964).
Raschet produckttsii zooplanktona.
Dokl. Akad. Nauk. S.S.S.R. 139, 1235-1238.

Pianka, E.R. (1981).
Competition and niche theory.
In: "Theoretical Ecology Principles and Applications", 2nd. edn., (May, R.M., ed.), pp 167-196.
Blackwell Scientific Publications, Oxford, Great Britain.

Pillai, N.K. (1963).
On a new mysid from the inshore waters of the Kerala coast.
J. Mar. Biol. Ass. India 5, 258-262.

Pillai, N.K. (1964).
Report on the Mysidacea in the collection of the Central Marine Fisheries Research Institute, Mandapam Camp, South India.
J. Mar. Biol. Ass. India 6, 1-41.

Pillai, N.K. (1973).
Mysidacea of the Indian Ocean.
I.O.B.S. Handbook 4, 1-125.

Rau, G.H. and Hedges, J.I. (1979).
Carbon-13 depletion in a hydrothermal vent mussel: suggestion of a chemosynthetic food source.
Science 203, 648-649.

Rau, G.H., Sweeney, R.E., Kaplan, I.R., Mearns, A.J. and Yobing, D.R. (1981).
Differences in animal ^{13}C, ^{15}N and D abundance between a polluted and an unpolluted coastal site: likely indicators of sewage uptake by a marine food web.
Est. Coast. Mar. Sci. 13, 701-707.

Reitsema, L.A. and Neff, J.M. (1980).
A recirculating artificial seawater system for the laboratory culture of Mysidopsis almyra (Crustacea: Pericaridea).
Estuaries 3, 321-323.

Richards, S.W. and Riley, G.A. (1967).
The benthic epifauna of Long Island Sound.
Bull. Bingham Oceanogr. Coll. 19, 89-135.

Ritz, D.A. and Hosie, G.W. (1982).
Production of the Euphausiid Nyctiphanes australis in Storm Bay, South-Eastern Tasmania.
Mar. Biol. 68, 103-108.

Robertson, A.I. (1982).
Population dynamics and feeding ecology of juvenile Australian salmon (Arripis trutta) in Western Port Victoria.
Aust. J. Mar. Freshw. Res. 33, 369-375.

Robertson, A.I. and Klumpp, D.W. (1983).
Feeding habits of the southern Australian garfish Hyporhamphus melanochir: a diurnal herbivore and nocturnal carnivore.
Mar. Ecol. Prog. Ser. 10, 197-201.

Robertson, A.I. and Mann, K.H. (1980).
The role of isopods and amphipods in the initial fragmentation of eelgrass detritus in Nova Scotia, Canada.
Mar. Biol. 59, 63-68.

Robinson, B.W. and Kasakabe, M. (1975).
Quantitative preparation of SO_2 for $^{34}S/^{32}S$ analyses from sulphides by combustion with cuprous oxide.
Anal. Chem. 7, 1179-1181.

Rochford, D.J. (1984).
Effects of the Leeuwin Current upon sea-surface temperatures of south-western Australia.
Aust. J. Mar. Freshw. Res. 35, 487-489.

Sackett, W.M., Eadie, B.J. and Exner, M.E. (1973).
Stable isotope composition of organic carbon in recent Antarctic sediments.
In: "Advances in Organic Geochemistry", pp 661-671.

Sale, P.F., McWilliam, P.S. and Anderson, D.T. (1978).
Faunal relationships among the near reef zooplankton at three locations of Heron Reef, Great Barrier Reef and seasonal changes in this fauna.
Mar. Biol. 49, 133-145.

Sars, G.O. (1869).
Undersogelser over Christiana-fjordens Dybvansfauna anstillede paa en i Sommeren 1868 foretagen Zoolisk Reise.
Nyt Mag. Naturv. 16, 305-362.

Sars, G.O. (1870).
Nye Dybvandscrustaceer fra Lofoten.
Forh. Vidensk. Selsk. Kristi. (1869) 147-174.

Sars, G.O. (1872).
Undersogelser over Hardanger fjordens fauna.
Forh. Vidensk. Selsk. Krist. (1871) 246-286.

Sars, G.O. (1883).
Preliminary notices on the Schizopoda of H.M.S. Challenger Expedition.
Forh. Vidensk. Selsk. Krist. 7, 1-43.

Sars, G.O. (1885).
Report on the Schizopoda collected by H.M.S. Challenger during the years 1873-1876.
The Voyage of H.M.S. "Challenger" 13 (37), 1-228.

Schiegel, W.E. and Vogel, J.C. (1970).
Deuterium content of organic matter.
Earth & Planet. Sci. Lett. 7, 307-313.

Schoener, T.W. (1974).
Resource partitioning in ecological communities.
Science 185, 27-39.

Sell, D.W. (1982).
Size frequency estimates of secondary production by Mysis relicta in Lakes Michigan and Huron.
Hydrobiologia 93, 69-78.

Shuskina, E.A. (1973).
Evaluation of the production of tropical zooplankton.
In: "Life Activity of Pelagic Communities in the Ocean Tropics", (Vinogradov, M.E., ed.), pp 172-183.

Siegfried, C.A., Kopache, M.E. and Knight, A.W. (1979).
The distribution and abundance of Neomysis mercedis in relation to the entrapment zone in the western Sacremento-San Joaquin Delta.
Trans. Am. Fish. Soc. 108, 260-268.

Siegfried, C.A. and Kopache, M.E. (1980).
Feeding of Neomysis mercedis (Holmes).
Biol. Bull. 159, 193-205.

Smith, B.N. and Epstein, S. (1970).
Biogeochemistry of the stable isotopes of hydrogen and carbon in salt marsh biota.
Plant Physiol. 46, 738-742.

Smith, B.N. and Epstein, S. (1971).
Two categories of $^{13}C/^{12}C$ ratios for higher plants.
Plant. Physiol. 47, 380-384.

Smith, S.I. (1873).
In: "Report upon the invertebrate animals of Vineyard Sound and adjacent waters", (Verrill, A.E., ed.).
Rept. U.S. Comm. Fish., 1871-2 1, 295-747.

Southward, A.J., Southward, E.C., Dando, P.R., Rau, G.H., Felback, H. and Flugel, H. (1981).
Bacterial symbionts and low $^{13}C/^{12}C$ ratios in tissues of Pognophora indicate unusual nutrition and metabolism.
Nature 293, 616-620.

Steele, K.W. and Daniel, R.M. (1978).
Fractionation of nitrogen isotopes by animals: a further complication to the use of ^{15}N for tracer studies.
J. Agric. Sci. 90, 7-9.

Stephenson, R.L., Tan, F.C. and Mann, K.H. (1984).
Stable carbon isotope variability in marine macrophytes and its implications for food web studies.
Mar. Biol. 81, 223-230.

Stephenson, W. (1962).
In: "The Evolution of Living Animals", (Leeper, C.W., ed.), pp 311-327.
Melbourne Univ. Press, Melbourne.

Taniguchi, A. (1974).
Mysids and Euphausiids in the Eastern Indian Ocean with particular reference to invasion of species from the Banda Sea.
J. Mar. Biol. Ass. India 16, 349-357.

Tattersall, O.S. (1952).
Report on a small collection of Mysidacea from estuarine waters of South Africa.
Trans. Roy. Soc. S. Africa 33, 153-187.

Tattersall, O.S. (1955).
Mysidacea.
Discovery Reports 28, 1-190.

Tattersall, O.S. (1957).
Report on a small collection of Mysidacea from the Sierra Leone estuary together with a survey of the genus Rhopalophthalmus Illig and a description of a new species of Tenagomysis from Lagos Nigeria.
Proc. Zool. Soc. Lond. 129, 81-128.

Tattersall, O.S. (1960).
Report on a small collection of Mysidacea from Singapore waters.
Proc. Zool. Soc. Lond. 135, 165-181.

Tattersall, O.S. (1965).
The Fauna of the Ross Sea.
New Zealand Dept. Sci. Indust. Res. Bull. 167, pp 35

Tattersall, W.M. (1909).
The Schizopoda collected by the "Maia" and "Puritan" in the Mediterranean.
Mitt. Zool. Stat. Neapel 19, 117-143.

Tattersall, W.M. (1911).
Schizopodous Crustacea from the northeast Atlantic slope.
Sci. Invest. Fish. Br. Ire., (1910), Suppl. II, 1-77.

Tattersall, W.M. (1918).
Euphausiacea and Mysidacea.
Sci. Rep. Australas. Antarct. Exped., Ser. C.-Zool. Bot. 5 (5), 1-15.

Tattersall, W.M. (1922).
Indian Mysidacea.
Rec. Ind. Mus. 24, 445-504.

Tattersall, W.M. (1923).
Crustacea. Pt VII Mysidacea.
In: "British Antarctic ("Terra Nova") Expedition 1910, Natural History Reports. London. British Museum (Natural History), Zoology 3", pp 273-304.

Tattersall, W.M. (1927).
Australian opossum shrimps (Mysidacea).
Rec. S. Aust. Mus. 3, 235-257.

Tattersall, W.M. (1928).
Further records of Australian opossum shrimps (Mysidacea).
Rec. S. Aust. Mus. 4, 105-110.

Tattersall, W.M. (1936a).
Mysidacea and Euphausiacea.
Sci. Rep. Gr. Barrier Reef Exped. 5, 143-179.

Tattersall, W.M. (1936b).
Plankton of the Bermuda oceanographic expeditions. V. Notes on the Schizopoda.
Zoologica 21, 95-96.

Tattersall, W.M. (1939).
The Euphausiacea and Mysidacea of the John Murray Expedition to the Indian Ocean.
Sci. Rep. John Murray Exped. 5, 203-246.

Tattersall, W.M. (1940).
Report on a small collection of Mysidacea from the coastal waters of New South Wales.
Rec. Aust. Mus. 20, 327-340.

Tattersall, W.M. (1943).
Biological results of last cruise Carnegie. IV. The mysids scientific results of cruise VII of the Carnegie during 1928-1929, Biology IV.
Publ. Carnegie Inst. Washington 201, 63-72.

Tattersall, W.M. (1951).
A review of the Mysidacea of the United States National Museum.
Bull. U.S. Natl. Mus. 201, 1-292.

Tattersall, W.M. and Tattersall, O.S. (1951).
The British Mysidacea.
Ray Soc. Lond. VIII+, 460.

Tchindonova, J.G. (1959).
Feeding of some groups of macroplankton in the northwestern Pacific.
Trudȳ Instituta Okeanologii, Akademiya Nauk. S.S.S.R. 30, 166-189.

Teraguchi, M., Hasler, A.D. and Beeton, A.M. (1975).
Seasonal changes in the response of Mysis relicta Loven to illumination.
Verein. Theoret. Angew. Limnol., Verhandl 19, 2889-3000.

Thayer, G.W., Parker, P.L., LaCroix, M.W. and Fry, B. (1978).
The stable carbon isotope ratio of an eelgrass Zostera marina bed.
Oecologia 35, 1-12.

Thomson, G.M. (1900).
On some New Zealand Schizopoda.
J. Linn. Soc. Lond., Zool. 27, 482-486.

Thorp, J.H. (1976).
Interference competition as a mechanism of co-existence between two sympatric species of the grass shrimp Palaemonetes (Decapoda: Palaemonidae).
J. Exp. Mar. Biol. Ecol. 25, 19-35.

Toda, H., Takahashi, M. and Ichimura, S. (1982).
Abundance and life history of Neomysis intermedia Czerniawsky in Lake Kasumigaura.
Hydrobiologia 93, 31-39.

Tregunna, E.B., Smith, B.N., Berry, J.A. and Downton, W.J.S. (1970).
Some methods for studying the photosynthetic taxonomy of the angiosperms.
Can. J. Bot. 48, 1209-1214.

Troughton, J.H., Cord, K.A. and Hendy, C.H. (1974).
Photosynthetic pathways and carbon isotope discrimination by plants.
Carnegie Inst. Washington 73, 768-780.

Udrescu, A. (1981).
Siriella bacescui sp.n. (Crustacea, Mysidacea) from the north-eastern Australian waters.
Trav. Mus. Hist. Nat."Grigore Antipa" 23, 29-32.

Valbonesi, A. and Murano, M. (1980).
Mysidae of shallow water in Tanabe Bay.
Publ. Seto Mar. Biol. Lab. XXV (1/4), 211-226.

Vanderploeg, H.A., Bowers, J.A., Chapelski, O. and Soo, H.K. (1982).
Measuring in situ predation by Mysis relicta and observations on underdispersed microdistributions of zooplankton.
Hydrobiologia 93, 109-119.

Vinogradov, M.E. (1962).
Feeding of the deep-sea zooplankton.
Rapports et Proces-verbaux des Réunions Counceil Permanent International pour l'exploration de la Mer. 153, 114-119.

Wainwright, P.F. and Mann, K.H. (1982).
Effect of antimicrobial substances of the ability of the mysid shrimp Mysis stenolepis to digest cellulose.
Mar. Ecol. Prog. Ser. 7, 309-313.

Waters, T.F. (1979).
Influence of benthos life history upon the estimation of secondary production.
J. Fish. Res. Bd. Can. 36, 1425-1430.

Waters, T.F. and Hokenstrom, J.C. (1980).
Annual production and drift of the stream amphipod Gammarus pseudolimnaeus in Valley Creek, Minnesota.
Limnol. Oceanogr. 25, 700-710.

Wiborg, K.R. (1962).
Estimation of numbers in the laboratory.
Rapports et Proces-verbaux des Réunions Counceil Permanent International pour l'exploration de la Mer. 153, 74-77.

Wigley, R.L. and Burns, B.R. (1971).
Distribution and biology of mysids (Crustacea, Mysidacea) from the Atlantic coast of the United States in the N.M.F.S. Woods Hole Collection.
Fish. Bull. U.S. 69, 717-746.

Willemoes-Suhm, R.V. (1873).
Von der "Challenger" expedition: Briefe an C.Th.E.v. Siebold, I.
Zeitschr. Wiss. Zool. 23, 1-7.

Willemoes-Suhm, R.V. (1874).
Von der "Challenger" expedition: Briefe an C. Th. E. v. Siebold, II.
Zeitschr. Wiss. Zool., Ser. 2 1, 23-59.

Wilson, J.B. and Roff, J.C. (1973).
Seasonal vertical distributions and diurnal migration patterns of Lake Ontario crustacean zooplankton.
Proc. of Sixth Conf. on Great Lakes Res. 190-203.

Winberg, G.G. (1971).
"Methods for the estimation of production of aquatic animals".
Soviet National Committee of IBP, Minsk. Translated from Russian.
Academic Press, London.

Wittmann, K.J. (1977).
Modification of association and swarming in north Adriatic Mysidacea in relation to habitat and interacting species.
In: "Biology of Benthic Organisms", - European Marine Biology Symposium, 11th., 1976, (Céidigh, P.Ó. & Boaden, P.J.S. eds.), pp 605-612.
Permagon Press.

Wittmann, K.J. (1978).
Adoption, replacement, and identification of young in marine Mysidacea (Crustacea).
J. Exp. Mar. Biol. Ecol. 32, 259-274.

Wittmann, K.J. (1981a).
Comparative biology and morphology of marsupial development in Leptomysis and other Mediterranean Mysidacea (Crustacea).
J. Exp. Mar. Biol. Ecol. 52, 243-270.

Wittmann, K.J. (1981b).
On the breeding physiology of marsupial development in Mediterranean Leptomysis (Mysidacea: Crustacea) with special reference to the effects of temperature and egg size.
J. Exp. Mar. Biol. Ecol. 53, 261-279.

Wittmann, K.J. (1982).
Investigations of the sexual biology of a Mediterranean mysid crustacean Leptomysis lingvura G.O. Sars.
Zool. ANZ. 209, 362-375.

Wittmann, K.J. (1984).
Ecophysiology of marsupial development and reproduction in Mysidacea (Crustacea).
Oceanogr. Mar. Biol. Ann. Rev. 22, 393-428.

Womersley, H.B.S. (1981).
Marine ecology and zonation of temperate coasts.
In: "Marine Botany: An Australasian Perspective", (Clayton, M.N. and King, R.J., eds.), pp 210-240.
Longman Cheshire, Melbourne.

Wong, W.W. and Sackett, W.M. (1978).
Fractionation of stable carbon isotopes by marine phytoplankton.
Geochim. Cosmochim. Acta. 42, 1809-1815.

Wood-Mason, J. and Alcock, A. (1891).
Natural history notes from H.M. Indian Marine Survey steamer "Investigator," Commander R.F. Hoskyn, R.N., commanding. No. 21. Note on the results of the last season's deep-sea dredging. Series II, No.1. On the results of deep-sea dredging during the season 1890-1891.
Ann. Mag. Nat. Hist. Ser. 6 7, 186-222.

Wooldridge, T. (1981).
Zonation and distribution of the beach mysid Gastrosaccus psammodytes (Crustacea: Mysidacea).
J. Zool. Lond. 193, 183-189.

Wooldridge, T.H. (1983).
Ecology of beach and surf-zone mysid shrimps in the Eastern Cape, South Africa.
In: "Sandy Beaches as Ecosystems", (McLachlan, A. and Erasmus, T., eds.).
Junk Publishers, The Hague.

Wooldridge, T.H. and Bailey, C. (1982).
Euryhaline zooplankton of the Sundays estuary and notes on trophic relationships.
S. Afr. J. Zool. 17, 151-163.

Wooldridge, T. and Erasmus, T. (1980).
Utilization of tidal currents by estuarine zooplankton.
Est. Coast Mar. Sci. 11, 107-114.

Wyrtki, K. (1960).
The surface circulation in the Coral and Tasman Seas.
Tech. Pap. Div. Fish. Oceanogr. C.S.I.R.O. Aust. No. 8, 44.

Yan, Z. (1982).
On the biology of Neomysis awatschensis (Crustacea, Mysidacea) I. Population and reproduction characteristics.
Oceanol. et Limnol. Sinica 13, 66-77.

Yigst, J.Y. (1976).
The utilization of organic matter in shallow marine sediments by an epibenthic deposit-feeding holothurian.
J. Exp. Mar. Biol. Ecol. 23, 55-69.

Zelickman, E.A. (1974).
Group orientation in Neomysis mirablis (Mysidacea: Crustacea).
Mar. Biol. 24, 251-258.

Zimmer, C. (1914).
Die Schizopoden der deutschen Sudpolar - Expedition 1901-1903.
In: **"Deutsche Sudpolar - Expedition 1901-1903. Georg Reimer, 15, zool., 7"**, (Drygalski, E.von, ed.), pp 377-445.

Zimmer, C. (1915).
Schizopoden der Hamburger Naturhistorischen (Zoologischen) Museum.
Mitt. Nat. Mus. Hamb. 32, 159-182.

Zimmer, C. (1918).
Neue une wenig bekannte Mysidaceen des Berliner Zoologischen Museums.
Mitt. Zool. Mus. Berlin 9, 13-26.

APPENDIX A : MYSID TAXONOMY AND DISTRIBUTION

APPENDIX A1 : Australian mysid genera and species not included in the world list given in Mauchline (1980).

Petalophthlamus australis Panampunnayil, 1982
Siriella bacescui Udrescu, 1981
Gastrosaccus daviei Bacescu and Udrescu, 1982
Haplostylus (G.) brisbanensis Bacescu and Udrescu, 1982
H.(G.)queenslandensis Bacescu and Udrescu, 1982
H.sp.1 n.sp.
Allomysis sp.1 n.g. n.sp.
Australomysis sp.1 n.sp.
Doxomysis proxima Bacescu and Udrescu, 1982
D.sp.1 n.sp.
Iimysis sp.1 n.sp.
Mysidetes halope O'Brien in press
Prionomysis sp.1 n.sp.
Tenagomysis sp.1 n.sp.
T.sp.2 n.sp.
T.sp.3 n.sp.
Anisomysis gracilis Panampunnayil, 1984
A.robustispina Panampunnayil, 1984
Halemysis australiensis Bacescu and Udrescu, 1984
Paramesopodopsis rufa n.g. n.sp.
Tasmanomysis oculata n.g. n.sp.
Heteromysis abrucei Bacescu, 1979
H.australica Bacescu and Bruce, 1980
H.harpaxoides Bacescu and Bruce, 1980
H.heronensis Bacescu, 1979
H.macrophthalma Bacescu, 1983
H.stellata Bacescu and Bruce, 1980
H.tethysiana Bacescu, 1983
Heteromysoides longiseta Bacescu, 1983
Mysidella sp.1 n.sp.
[Genus Notomysis is also included represented by the species Leptomysis (Notomysis n.g.) australiensis]

APPENDIX A2 : Distribution of mysids in Tasmania

METHODS:

Mysids were collected by a variety of methods including plankton nets, boat deployed dredges and SCUBA diver in a variety of habitats around southern Tasmania.

RESULTS:

The species present at all sites sampled are listed below:

South-eastern Tasmania (Sites in south-eastern Tasmania are shown in Fig. A).

Greenhead: Paramesopodopsis rufa, Anisomysis mixta australis, Tenagomysis sp.2.

Sloping Island: P.rufa, A.mixta australis.

Tasman Bay: P.rufa, Doxomysis sp.1.

Isle of Caves: P.rufa.

Hog Island: P.rufa, A.mixta australis.

Partridge Island: P.rufa, T.sp.1, D.sp.1, Leptomysis australiensis, T.sp.2, Australomysis acuta.

Southerly Bight: T.sp.1, T.sp.2, P.rufa, L.australiensis.

Tin Pot Point: T.sp.2, D.sp.1.

Blow-hole Tasman Peninsula: P.rufa, L.australiensis, T.sp.2, D.sp.1, A.acuta.

Clydes Island: Australerythrops paradicei

Catamaran River: Tasmanomysis oculata

Maatsuyker Island: P.rufa, T.sp.2.

D'Entrecasteaux Channel: T.oculata, Paranchialina angusta.

Middleton: Siriella australis

Recherche Bay: A.mixta australis, D.sp.1.

Fossil Island: T.sp.1

White Beach: P.rufa.

Tinderbox: P.rufa, D.sp.1

Taroona Beach: D.sp.1, P.rufa.

Kingston Beach: P.rufa.

Margate Beach: S.australis, S.vincenti, A.acuta, T.oculata.

Hope Beach: T.sp.1, T.sp.2, T.sp.3, Prionomysis sp.1, Allomysis sp.1.

Bruny Island

Variety Bay: T.sp.1

Moorina Bay: P.rufa, Australomysis incisa, Prionomysis sp.1

APPENDIX A2 ctd.

Bruny Island ctd

Adventure Bay: P.rufa, T.oculata, A.mixta australis.

One Tree Point: Allomysis sp.1, A.mixta australis, A.acuta, A.incisa, D.sp.1, Iimysis sp.1, Haplostylus sp.1, L.australiensis, T.oculata, T.sp.1, T.sp.2, P.rufa, Prionomysis sp.1, S.australis.

Sites elsewhere in Tasmania

Granville Harbour: A.mixta australis, T.sp.1

Boat Harbour: P.rufa.

Maria Island, Darlington: S.vincenti.

Maria Island, Chinaman's Bay: P.angusta

Bicheno: Australomysis sp.1

Schouten Island, Passage Beach: P.rufa.

Schouten Island, Sandspit Point: A.mixta australis, P.rufa, T.sp.2.

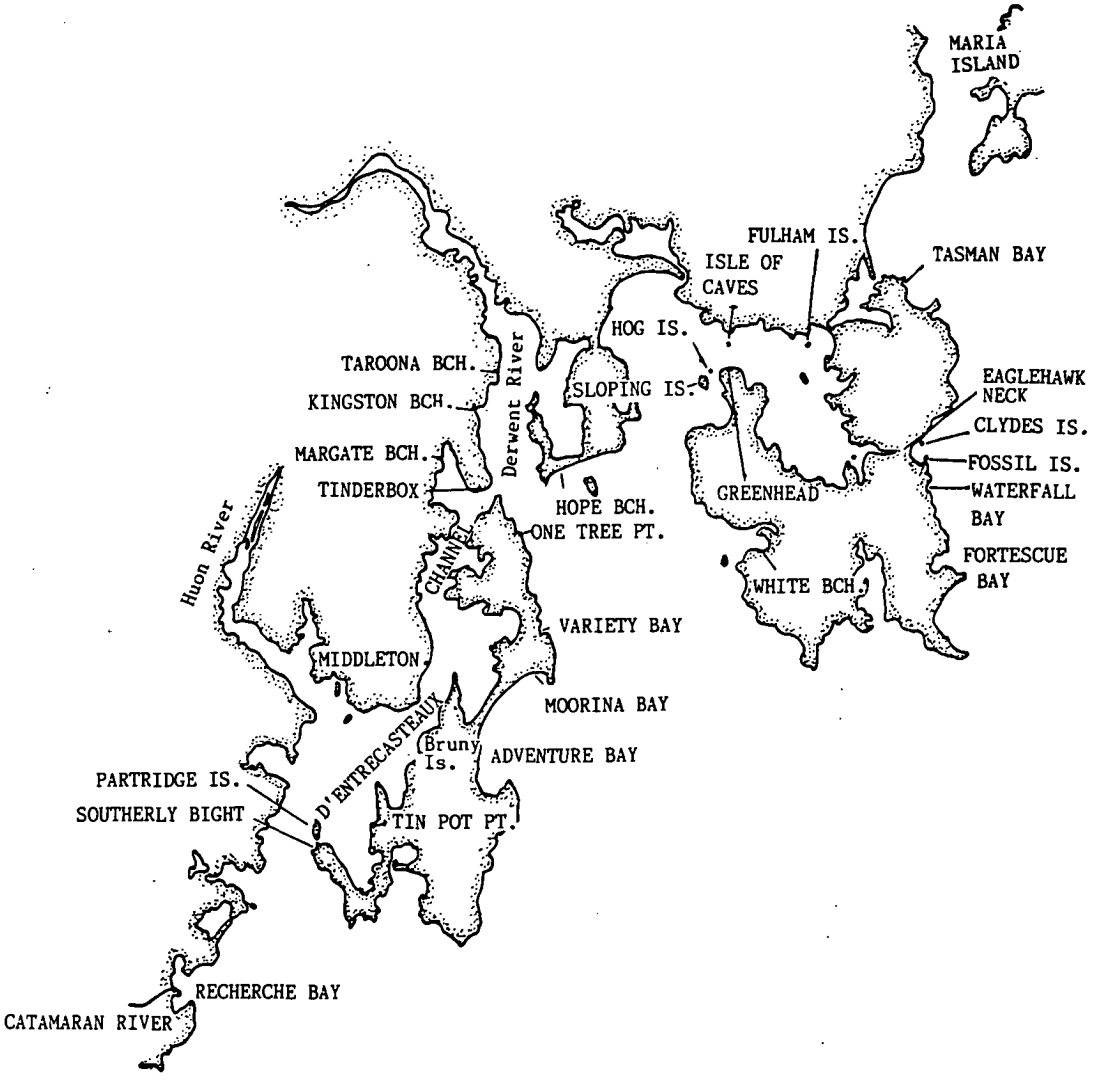


Fig. A Sites sampled for mysids in south-eastern Tasmania.

APPENDIX A3 : Results of the Bass Strait Survey.
The stations sampled are shown in Fig. B.

Stn	J	Lat. °S	Long. °E	Depth	Sediment	Sampling Method	Species
48	9519	39°01.1'	143°49.2'	82	Coarse sand	Dredge	3 A.incisa 1M, 2damaged
50	9512	39°00'	143°32'	81	Very coarse sand	Dredge	1F H.(G.)indicus damaged
52	9520	38°56.7'	143°26.8	49	Very coarse sand	Dredge	1M H.(G.)indicus 1M S.australis
53	9516	38°55.2'	143°24.5'	68	Very coarse sand	?	2 S.australis 1 H.(G.)indicus 1M Pseudomysidetes sp.
55	9521	39°09'	143°26'	86	Fine sand	Dredge	12 H.sp.1
67	9509	39°25.5'	145°57.4'	115	Medium fine sand	?	1 Rhopalophthalmus sp.
75	9523	39°17'	143°38.7'	88	Medium fine sand	Grab	H.sp.1
78	9515	39°22'	143°28.4'	106	Coarse sand	Dredge	Euphausiid
81	9513	39°27.8'	143°17.3'	104	Medium fine sand	Grab	1 Decapod damaged
89	9517	40°04.2'	143°22.2	110	Medium sand	?	1 P.angusta 1 Euphausiid
90	9514	40°04.3'	143°21.6'	113	Medium sand	Grab	1 P.angusta
107	5410	39°33	144°16	18	Fine sand	GSM	3 P.angusta
	5439					SEB	4F T.sp.1 ? 1J P.rufa 12 P.angusta
	5376						Majority P.angusta 1F A.incisa damaged 1M A.acuta ? 4J Tenagomysis sp.

APPENDIX A3 ctd.

Stn	J	Lat. °S.	Long. °E	Depth	Sediment	Sampling Method	Species
108	5465	39°33'	144°21'	27	Fine sand	SEB	1 H.waitei 1 H.tasmanica ? 1 S.australis
	5444					SEB	28 P.angusta 8 A.incisa 11 L.australiensis 2 S.australis 1 T.sp.1 1 Decapod
109	5383	40°31'	144°56'	27	Very coarse sand	SEB	1 S.australis 8 H.waitei
	5420					GSM	2 J Tenagomysis sp. ?
110	5390	40°42'	145°07'	16	Fine shelly sand	SEB	3 A.incisa 1 unrecognizable
	5419					SEB	1J cleft telson sp. ?
111	5403	40°31'	145°17'	40	Sand	SEB	2 A.incisa 2 A.acuta P.angusta L.australiensis T.sp.1 M.sp.1
112	5441	40°22'	145°17'	40	Sand	SEB	7 S.vincenti 1 P.angusta 1 Decapod
113	5435	40°24'	145°32'	65	Muddy shelly sand	GSM	Euphausiids Decapods
	5430						2 S.vincenti 1 P.angusta 2 H.waitei
114	5387	40°49'	145°22'	22	Fine sand	SEB	9 S.vincenti 6 P.angusta 4 Doxomysis sp. 3J Tenagomysis sp. 1 H.sp

APPENDIX A3 ctd.

Stn	J	Lat. °S	Long. °E	Depth	Sediment	Sampling Method	Species
115	5388	40°40'	145°15'	32	Medium shelly sand	GSM	1J P.angusta 1 Decapod
	5442					SEB	21 P.angusta 5 S.vincenti 5 M.sp.1 2 A.incisa 1 T.sp.2
116	5436	40°32'	145°23'	43	Muddy shell-grit	GSM	1M P.angusta 1 Euphausiid
	5433					SEB	17 S.vincenti 3 P.angusta 2 H.tasmanica
117	5391	40°38'	145°23'	36	Muddy shell-grit	GSM	2 S.vincenti 1 P.angusta
	5396					SEB	13 S.vincenti 6 P.angusta 1 H.sp 1 Decapod 1 Euphausiid
	5398					SEB	1 P.angusta 1 S.australis 1 Euphausiid
	5434					SEB	1 S.vincenti 1 H.sp 1 ? damaged
118	5378	39°06'	143°35.8'	95	Fine sand	SEB	Majority P.angusta A.incisa H.sp.1 2 M.sp.1
	5409					GSM	1F H.sp.1
119	5393	39°06'	143°28.7'	92	Fine sand	SEB	P.angusta H.sp.1 A.incisa L.australiensis
120	5382	39°01'	143°22'	84	Sand	SEB	Majority P.angusta A.incisa 2J H.sp.1 1J P.australis
121	5395	39°01'	143°15.2'	84	Fine sand	SEB	A.incisa P.angusta H.sp.1

APPENDIX A3 ctd.

Stn	J	Lat. °S	Long. °E	Depth	Sediment	Sampling Method	Species
Q659	5408 (=Stn.121)						A.incisa
125	5422	40°48.3' 40°49.7'	144°17.1' 144°14.4'	99 102	Coarse sand	Trawl	Euphausiid
126	5385	40°48.1'	144°38'	42	No sample	GSM	1 S.australis 1J P.angusta
135	5377	40°49.8' 40°48.2'	146°31.3' 146°33.7'	68 70	Mud	Trawl	1F T.sp.2 ?
138	5415	40°08.9' 40°08.8'	147°31.8' 147°29.3'	51 52	Very coarse shell	Trawl	1 H.tasmanica 1 Amphipod
154	5386	38°33.4'	144°54.9'	55	Coarse shell	SEB	1 P.angusta 1 S.australis 5 damaged mysids 2 Decapods 1 Amphipod
155	5427	38°55.5'	145°17'	70	Fine mud	GSM	1 P.angusta damaged
156	5406	39°45.9'	145°33.3'	74	Shell bryozoa mud	SEB	10 P.angusta 7 S.vincenti 5 M.sp.1
	5413					GSM	3 P.angusta 1F S.vincenti
	5445					SEB	1M P.australis 1 Decapod
157	5421	40°10.9'	145°44.3'	75	Shell bryozoa mud	GSM	1 Siriella sp. damaged
	5438					GSM	Euphausiid
	5448						1 Siriella sp. damaged
158	5407	39°48.6'	146°18.8'	82	Shell bryozoa mud	SEB	Majority S.vincenti P.angusta D.sp.1 ? damaged 1 H.sp
	5412					GSM	1F T.sp.2
159	5417	39°46'	148°18'	80	Shell bryozoa mud	GSM	T.sp.2
	5446					SEB	39 T.sp.2 1Fi D.sp.1 4 H.sp damaged

APPENDIX A3 ctd.

Stn	J	Lat. °S	Long. °E	Depth	Sediment	Sampling Method	Species
164	5379	40°43.8'	148°37.2'	67	Muddy very fine bryozoa shell	GSM	35 P.angusta 7 P.australis 5 P.australe T.sp.2 Doxomysis sp. damaged
165	5394	40°13.8'	148°39.6'	60	Muddy sand	SEB	Majority P.australe T.sp.2 5 M.sp.1
	5397					GSM	1 P.australe
166	5392	40°06.2'	148°25'	22	Coarse shell	SEB	Majority A.acuta 3 S.australis 2 L.australiensis 2 D.sp.1 T.sp.2 ?
167	5400	39°44.8'	148°40.6'	124	Fine sand & mud	GSM	1 P.australe 1 ? badly damaged
	5416						1 P.australe
169	5380	39°02.8'	148°30.6'	120	Sandy mud	SEB	2 poor condition
	5401						2 P.australe
171	5433	38°53.7'	147°55.2'	71	Shelly sand	SEB	3 P.angusta 3 A.incisa ? damaged
177	5423	38°53.7'	147°06.5'	58	Coarse shell	SEB	3F,2M S.australis
	5424					GSM	1 S.vincenti damaged
178	5389	38°43.4'	146°56.9'	26	No sample	SEB	4 S.halei 1 Australomysis ? damaged
	5399					SEB	3 H.sp damaged 1?
180	5413	39°12.9'	146°27.3'	65	Muddy sand	SEB	P.angusta
181	5425	38°39.8'	144°18.2'	79	Very fine sand	SEB	2 P.angusta 2M S.australis 1 H.tasmanica 1 Euphausiid
183	5450	39°07'	143°14.6'	84	Sandy shell	SEB	P.australis damaged

APPENDIX A3 ctd.

Stn	J	Lat. °S	Long. °E	Depth	Sediment	Sampling Method	Species
184	5411	39°49'	143°24'	56	Fine sand	SEB	A.incisa P.angusta H.sp.1 L.australiensis S.australis T.sp.2 M.sp.1
	5437					GSM	2J H.sp.1
186	5440	38°50'	143°07.5'	69	Fine sand	GSM	4 H.sp.1
192	5384	39°06.7'	143°07.4'	81	Sandy shell	D.R.	1F S.vincenti
194	5429	39°26.3'	143°06.8'	115	Sandy shell	SEB	11 P.angusta 2F A.incisa damaged
197	5447	40°00.7'	143°49.9'	46	Very fine sand	SEB	7 S.vincenti 1 P.angusta
201	5404	39°08.3'	144°43.9'	66	Sandy shell	SEB	7 P.angusta 1 T.sp.2 damaged
	5414						2 Euphausiids
202	5426	39°00.2'	144°33.9'	74	Sandy shell	GSM	1F P.australis
	5449					SEB	10 P.angusta 1M T.sp.2 1 H.sp
205	5405	39°13.6'	143°55.6'	85	Fine sandy shell	GSM	1 P.angusta
	5418						4 P.angusta 1 Siriella sp.
206	9524	37°50'	148°16'	26	Coarse sand	SEB	1F H.sp.1
207	9511	37°59'	148°27'	51	Muddy sand with fine shell	SEB	8 P.angusta 2 A.acuta damaged
208	9522	37°50'	148°40'	26	Medium sand	SEB	3 A.incisa damaged 1 T.sp.1 1 damaged

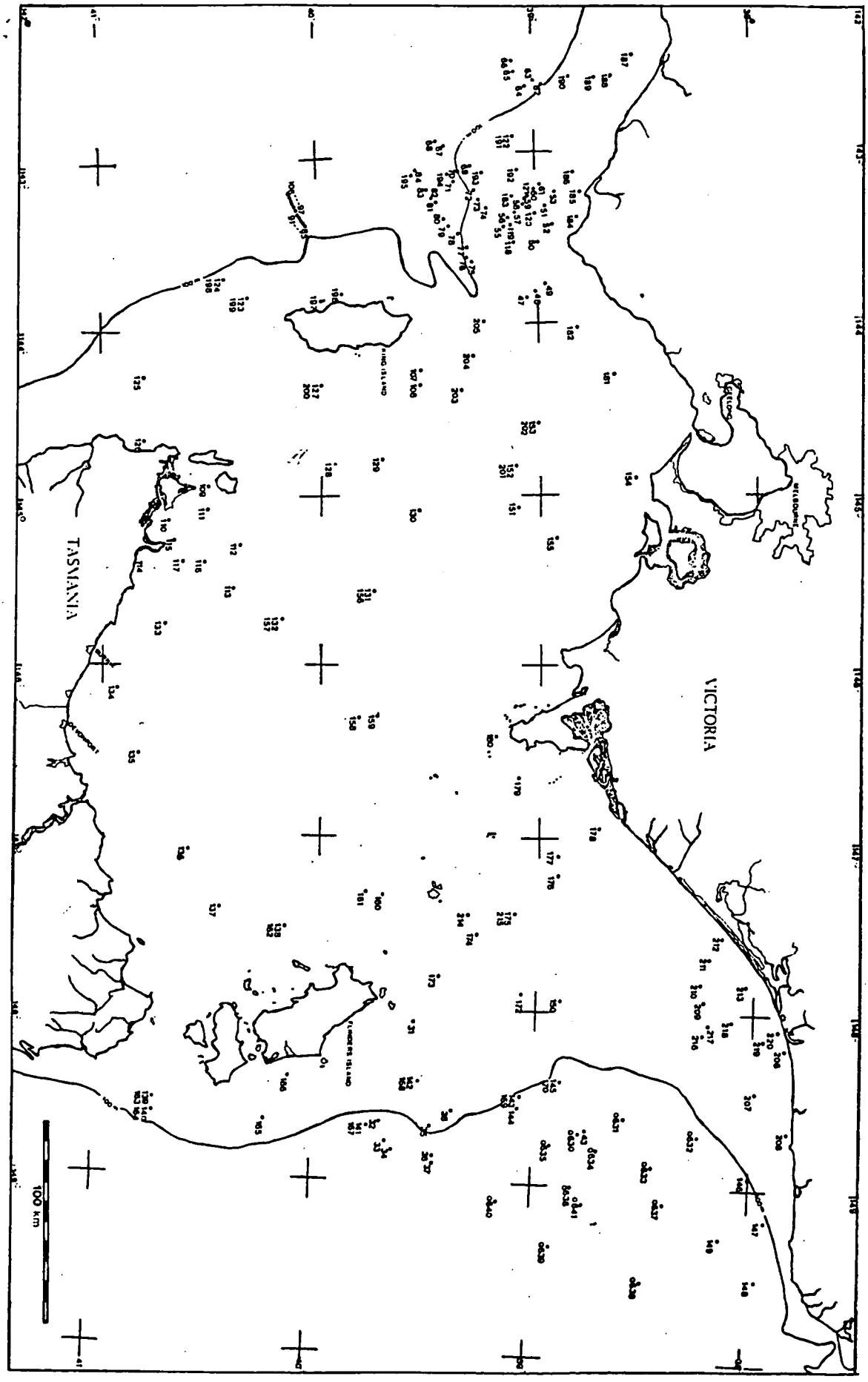
APPENDIX A3 ctd.

Stn	J	Lat. °S	Long. °E	Depth	Sediment	Sampling Method	Species
209	9518	38°18.5'	147°15'	55	Muddy fine shell	SEB	10 P.angusta 3 S.vincenti 1 H.tasmanica 1 H.waitei
212	9510	38°15	147°22'	16	Clean sand with limestone reef outcrops	SEB	4 H.waitei 3 P.sp.1 2 T.sp.1 1 S.vincenti
Q654	5402	38°56.4'	143°51'	79	Fine sand	SEB	3 M.sp.1 1 D.sp.1
?	5428	40°40'	145°00				2M S.vincenti

Abbreviations used in the Bass Strait results include:

SEB = Epibenthic sled
GSM = Smith-McIntyre Grab
DR = Rock dredge
F = Female
M = Male
i = Immature
J = Juvenile

Fig. B Location of Bass Strait sampling stations.



APPENDIX B : HABITAT AND MYSID DATA.

APPENDIX B1: Temperature and Salinity Data.

MONTH	ONE TREE POINT			HOSIE (1982) DATA		
	DEPTH (m)	T (^{o}C)	S^{o}/oo	DEPTH (m)	T (^{o}C)	S^{o}/oo
September	-	-	-	0	11.8	29.09
	-	-	-	4	11.4	34.48
October	0	12.3	34.59	0	13.8	28.39
	3	12.0	34.59	4	12.2	34.18
November	-	-	-	0	16.8	32.17
	-	-	-	5	14.3	33.84
December	-	-	-	0	16.1	32.72
	-	-	-	5	15.2	33.82
January	-	-	-	0	18.0	33.22
	-	-	-	5	17.0	33.90
February	-	-	-	0	18.5	33.93
	-	-	-	5	17.8	34.43
March	-	-	-	0	16.8	34.66
	-	-	-	5	16.8	34.74
April	0	14.3	34.11	0	14.4	-
	4	14.3	34.11	3.5	14.4	-
May	0	13.0	34.40	0	12.1	33.50
	4	13.0	34.40	7	12.8	34.88
June	0	11.7	34.25	0	11.6	34.04
	4	12.0	34.50	4	12.0	34.57
July	0	10.3	34.4	0	10.5	32.6
	4	10.4	34.41	4	10.5	32.85
August	0	10.5	34.3	0	10.7	32.0
	4	10.45	34.45	5	11.0	34.54

APPENDIX B2: Sediment Organic Content Data: Percentage of organic matter (OM) in sediment samples collected at One Tree Point throughout the year at Sites A, B and C.

MONTH	DEPTH (m)	SITE A %OM	SITE A MONTHLY MEAN %	SITE B %OM	SITE B MONTHLY MEAN %	SITE C %OM	SITE C MONTHLY MEAN %
September	-	1.35	1.17	1.28	1.19	1.1	1.18
	-	0.98		1.1		1.26	
October	2	2.1	2.25	1.63	1.68	0.96	0.84
	4	2.4		1.73		0.72	
November	2	3.5	2.84	2.54	2.62	2.87	2.74
	4	2.18		2.7		2.6	
December	2	2.15	2.10	2.55	2.96	1.95	1.19
	4	2.04		3.36		0.43	
January	2	1.3	1.53	1.23	1.32	0.84	0.9
	4	1.76		1.4		0.96	
February	2	1.1	1.3	1.0	1.0	0.5	1.1
	4	1.5		1.0		1.7	
March	2	0.63	1.31	0.83	0.99	0.93	1.1
	4	1.99		1.14		1.26	
April	2	3.25	2.08	0.94	0.77	0.36	0.71
	4	0.91		0.59		1.06	
May	2	2.1	2.3	0.76	0.82	0.9	0.94
	4	2.5		0.87		0.97	
June	2	0.72	0.61	0.33	0.57	0.25	0.44
	4	0.50		0.80		0.63	
July	2	0.66	0.66	0.87	0.83	0.69	0.67
	4	-		0.79		0.65	
August	2	0.8	0.95	0.94	1.02	1.5	1.18
	4	1.1		1.1		0.86	
Shallow samples		$\bar{x}$ = 1.64 SD = 0.99		$\bar{x}$ = 1.24 SD = 0.69		$\bar{x}$ = 1.07 SD = 0.74	
Deep Samples		$\bar{x}$ = 1.62 SD = 0.67		$\bar{x}$ = 1.38 SD = 0.84		$\bar{x}$ = 1.09 SD = 0.59	
Total		$\bar{x}$ = 1.63 SD = 0.83		$\bar{x}$ = 1.31 SD = 0.75		$\bar{x}$ = 1.08 SD = 0.65	

APPENDIX B3: Sediment Particle Size Data :Particle size composition at Site A throughout the year.

MONTH	PARTICLE SIZE (ϕ)						
	-1	0	1	2	3	4	5
	2.0mm	1.0mm	500um	250um	125um	63um	<63um
Site A: Shallow							
September	-	0.1	0.63	27.87	69.98	1.29	0.13
October	-	-	0.11	6.78	87.84	5.11	0.16
November	0.06	0.03	0.03	9.13	85.63	4.63	0.50
December	-	-	0.05	9.49	86.14	4.08	0.24
January	0.06	0.29	1.59	45.73	50.65	0.89	0.79
February	0.47	1.75	1.72	13.72	77.53	4.25	0.56
March	0.14	0.02	0.41	5.63	84.60	7.45	1.75
April	9.57	6.89	5.96	13.89	58.18	4.12	1.39
May	19.94	10.61	9.43	22.9	34.56	1.24	1.32
June	10.45	4.22	2.94	16.07	62.2	2.72	1.40
July	-	-	-	-	-	-	-
August	12.92	2.16	1.15	19.77	61.08	2.52	0.40
Total $\bar{x}$ =	4.87	2.37	2.18	17.36	68.95	3.48	0.79
SD =	7.1	3.52	2.97	11.65	17.30	1.98	0.58
n =	11	11	11	11	11	11	11
Site A: Deep							
September	0.08	0.19	1.06	30.02	66.53	1.96	0.16
October	60.12	12.34	5.24	6.13	15.32	0.68	0.17
November	23.22	5.07	4.13	14.07	49.6	3.64	0.27
December	4.11	3.94	4.89	9.0	71.19	6.39	0.47
January	0.01	0.01	0.86	43.53	53.46	0.96	1.17
February	3.37	3.22	8.82	43.55	39.65	0.92	0.48
March	4.21	1.08	1.15	19.41	69.41	3.4	1.34
April	6.17	1.24	4.00	46.68	39.45	1.09	1.37
May	1.62	0.87	1.13	16.01	75.27	3.89	1.21
June	20.61	4.74	3.05	29.38	40.10	1.11	1.01
July	0.0	0.02	0.03	17.11	80.11	1.94	0.79
August	2.35	0.89	0.87	15.92	75.46	4.05	0.46
Total $\bar{x}$ =	5.98	1.93	2.73	25.88	60.02	2.67	0.79
without SD =	8.14	1.93	2.60	13.5	15.9	1.75	0.45
October n =	11	11	11	11	11	11	11
Total $\bar{x}$ =	10.49	2.80	2.94	24.23	56.30	2.50	0.74
SD =	17.45	3.52	2.58	14.09	19.88	1.77	0.46
n =	12	12	12	12	12	12	12

APPENDIX B3 ctd. Particle size composition at Site B throughout the year.

MONTH	PARTICLE SIZE (ϕ)						
	-1	0	1	2	3	4	5
	2.0mm	1.0mm	500um	250um	125um	63um	<63um
Site B: Shallow							
September	0.12	0.02	0.26	16.12	80.08	2.95	0.45
October	0.02	0.02	0.73	30.77	66.81	1.29	0.31
November	0.00	0.09	1.03	28.38	68.21	2.24	0.06
December	0.02	0.05	0.35	9.93	84.71	4.82	0.13
January	0.13	0.06	0.45	24.15	69.62	4.03	1.56
February	0.24	0.64	1.42	19.76	74.39	3.24	0.30
March	0.07	0.16	0.86	40.85	55.22	2.17	0.67
April	0.03	0.01	0.23	19.66	76.00	3.23	0.84
May	0.15	0.06	0.34	15.51	79.31	3.79	0.84
June	0.13	0.06	0.45	24.15	69.62	4.03	1.56
July	0.02	0.06	0.33	19.87	76.54	3.03	0.15
August	0.10	0.51	1.58	26.39	68.00	3.00	0.42
Total $\bar{x}$ =	0.09	0.15	0.67	22.96	72.38	3.15	0.61
SD =	0.07	0.21	0.46	8.13	7.81	0.96	0.51
n =	12	12	12	12	12	12	12
Site B: Deep							
September	0.33	0.13	0.57	8.74	83.71	6.42	1.05
October	0.54	0.19	0.80	21.67	71.89	4.78	0.14
November	0.00	0.03	0.62	25.74	70.74	2.24	0.65
December	0.18	1.06	1.62	20.56	67.53	8.79	0.27
January	0.37	0.44	1.36	25.20	63.57	8.00	1.06
February	0.57	0.89	2.03	21.49	68.80	5.43	0.80
March	2.87	0.48	1.19	26.98	61.06	6.35	1.07
April	0.31	0.29	0.78	16.96	72.69	7.99	0.98
May	-	-	-	-	-	-	-
June	0.56	0.46	1.21	19.63	68.07	9.05	1.02
July	0.39	0.25	0.89	19.94	72.10	5.15	1.28
August	0.93	0.99	1.66	18.42	68.31	9.31	0.38
Total $\bar{x}$ =	0.64	0.47	1.16	20.49	69.86	6.68	0.79
SD =	0.78	0.36	0.47	5.00	5.82	2.19	0.38
n =	11	11	11	11	11	11	11

APPENDIX B3 ctd. Particle size composition at Site C throughout the year.

MONTH	PARTICLE SIZE (ϕ)						
	-1	0	1	2	3	4	5
	2.0mm	1.0mm	500um	250um	125um	63um	<63um
Site C: Shallow							
September	36.53	9.49	7.88	16.41	28.30	1.36	0.02
October	0.55	0.77	3.59	43.52	50.41	0.96	0.20
November	0.0	0.02	0.6	28.78	69.06	1.36	0.18
December	-	-	-	-	-	-	-
January	-	0.03	0.76	31.83	65.76	1.44	0.17
February	0.0	0.87	1.38	21.78	72.89	2.87	0.22
March	0.02	0.02	0.21	31.03	68.22	1.37	0.5
April	0.0	0.01	0.34	38.00	59.48	1.03	1.14
May	0.0	0.03	1.43	43.02	52.87	1.17	1.48
June	0.0	0.01	0.55	30.65	65.92	1.95	0.92
July	0.0	0.08	0.73	37.63	60.06	0.85	0.21
August	0.63	1.98	3.01	28.02	63.53	2.33	0.50
Total $\bar{x}$ =	0.12	0.38	1.26	33.43	62.79	1.53	0.55
without SD =	0.25	0.65	1.15	6.95	7.20	0.65	0.47
September n =	10	10	10	10	10	10	10
Total $\bar{x}$ =	3.43	1.21	1.86	31.88	59.66	1.52	0.50
SD =	11.0	2.81	2.28	8.36	12.44	0.62	0.47
n =	11	11	11	11	11	11	11
Site C: Deep							
September	75.49	3.58	1.31	3.58	15.05	0.74	0.26
October	-	0.03	1.8	36.29	59.71	1.31	0.86
November	0.02	0.42	2.60	43.08	52.64	0.94	0.30
December	-	-	0.29	19.53	76.53	3.31	0.33
January	7.45	1.62	0.87	8.04	76.25	4.16	1.61
February	-	0.11	0.96	16.29	77.68	4.46	0.5
March	-	-	-	-	-	-	-
April	0.0	0.31	1.0	27.72	68.09	2.38	0.5
May	1.45	1.40	3.76	38.87	51.43	2.01	1.08
June	1.67	0.78	2.33	47.23	45.30	1.54	1.15
July	3.15	1.38	2.28	24.56	65.44	2.06	1.13
August	3.64	1.47	2.61	29.44	58.01	4.29	0.54
Total $\bar{x}$ =	1.74	0.75	1.85	29.11	63.11	2.65	0.8
without SD =	2.44	0.66	1.06	12.44	11.53	1.31	0.43
September n =	10	10	10	10	10	10	10
Total $\bar{x}$ =	8.44	1.01	1.80	26.79	58.74	2.47	0.75
SD =	22.36	1.06	1.02	14.09	18.15	1.37	0.44
n =	11	11	11	11	11	11	11

APPENDIX B4 : Density (number of individuals m^{-3}) of mysids collected during the 24-hour sampling sessions.
a) October 1982.

SPECIES	TIME							
	1200	1500	1800	2100	0000	0300	0600	0900
Site A								
T.sp.2	92.4	60.39	66.01	67.98	19.38	8.71	716.29	1.12
A.mixta australis	140.45	36.80	403.09	5.34	0.84	1.97	85.67	164.33
P.rufa	41.29	120.79	7.02	96.91	98.88	56.46	87.08	3.37
T.sp.1	-	-	-	7.30	7.58	2.25	1.41	-
A.acuta	-	-	-	1.68	0.28	-	-	1.96
L.australiensis	-	0.56	-	0.84	0.56	-	-	-
S.australis	-	-	-	2.8	-	1.68	-	-
Site B								
T.sp.2	0.28	0.56	0.56	0.56	1.12	1.12	-	-
A.mixta australis	3.65	1.69	0.28	2.25	0.56	0.56	0.56	0.56
P.rufa	1.40	0.56	-	13.20	7.02	10.11	-	-
T.sp.1	0.28	-	-	0.56	0.56	0.28	-	-
A.acuta	-	-	-	1.12	-	-	-	-
Site C								
T.sp.2	-	-	-	7.58	6.74	1.12	8.43	-
A.mixta australis	0.56	0.28	0.28	1.69	0.56	0.56	73.60	3.09
P.rufa	3.65	10.11	1.97	378.93	33.71	16.01	2.81	-
T.sp.1	-	-	-	6.16	23.25	0.56	64.99	-
A.acuta	-	-	1.12	3.64	-	-	-	-
D.sp.1	-	-	-	0.84	-	0.28	-	-
S.australis	-	-	-	-	-	0.56	-	-

APPENDIX B4 ctd. : Density (number of individuals m^{-3}) of mysids collected during the 24-hour sampling sessions.
b) January 1983.

SPECIES	TIME							
	1200	1500	1800	2100	0000	0300	0600	0900
Site A								
T.sp.2	-	3.65	101.69	-	29.49	36.24	1.69	11.24
A.mixta australis	28.65	10.67	61.24	96.63	316.01	103.09	168.82	196.63
P.rufa	266.57	53.09	14.89	1.69	73.03	110.11	4.21	2.81
T.sp.1	-	-	-	-	-	-	-	1.40
A.acuta	0.28	8.40	0.84	-	4.20	-	-	-
S.australis	-	-	-	-	4.20	1.96	-	-
D.sp.1	-	-	0.84	-	-	-	-	-
Site B								
T.sp.2	-	76.40	0.56	-	7.02	3.09	-	-
A.mixta australis	8.71	24.72	0.28	0.56	53.09	33.15	31.74	4.21
P.rufa	1.40	1.40	0.28	-	3.65	3.93	0.56	-
T.sp.1	-	1.12	-	-	0.28	-	-	-
A.acuta	-	0.56	-	-	-	-	-	-
S.australis	-	-	-	-	0.84	-	-	-
H.sp.1	-	-	-	-	-	0.28	-	-
Allomysis sp.1	-	0.28	-	-	-	-	-	-
T.oculata	-	-	-	-	0.28	-	-	-
Site C								
T.sp.2	1094.1	1359.6	1056.2	1429.8	272.47	547.75	207.87	410.11
A.mixta australis	250.0	205.06	-	2.81	33.71	39.33	14.05	50.56
P.rufa	118.0	351.12	75.84	266.85	609.55	660.11	6.18	16.85
T.sp.1	-	28.09	19.66	28.09	5.62	56.18	0.84	16.85
A.acuta	-	-	-	-	2.81	-	-	-

APPENDIX B4 ctd. : Density (number of individuals m^{-3}) of mysids collected during the 24-hour sampling sessions.
c) April 1983.

SPECIES	TIME							
	1200	1500	1800	2100	0000	0300	0600	0900
Site A								
T.sp.2	73.0	1033.7	3904.5	50.56	19.66	25.3	1477.5	985.96
A.mixta australis	1286.5	272.5	561.8	155.9	415.7	251.4	50.56	199.44
P.rufa	11.24	1.40	-	110.96	50.56	36.52	112.36	16.85
T.sp.1	2.81	8.71	28.09	-	2.81	1.40	11.24	8.43
A.acuta	2.81	-	-	1.40	-	-	-	-
L.australiensis	-	0.56	-	-	-	1.40	11.24	-
S.australis	-	-	-	-	2.81	2.81	-	-
D.sp.1	-	-	-	-	2.81	-	-	-
Site B								
T.sp.2	1.12	2.25	16.57	1.12	4.49	1.69	0.56	0.28
A.mixta australis	1.69	4.49	40.45	18.26	192.14	35.67	18.82	5.90
P.rufa	17.42	-	23.88	3.65	8.99	0.28	-	0.56
T.sp.1	-	-	-	-	-	0.28	-	-
A.acuta	0.28	-	-	0.28	-	-	-	-
S.australis	-	-	0.28	-	2.24	-	-	-
L.australiensis	1.12	-	1.69	-	-	-	-	-
P.sp.1	-	-	0.28	0.56	-	0.28	-	-
A.incisa	-	-	0.28	-	-	0.28	-	-
Iimysis sp.1	-	-	2.24	-	-	1.12	3.08	0.28
Site C								
T.sp.2	179.8	198.0	1182.6	559.0	286.52	30.62	21.07	679.78
A.mixta australis	52.53	67.42	44.94	314.61	67.42	33.99	40.73	11.24
P.rufa	-	-	126.4	514.05	221.91	14.89	269.66	216.29
T.sp.1	17.14	56.18	11.24	5.62	-	-	12.64	39.33
A.acuta	-	-	-	2.81	-	-	8.40	11.24
S.australis	-	-	11.24	2.81	2.81	0.28	-	-
L.australiensis	-	-	2.81	-	5.60	-	-	-
P.sp.1	-	-	-	-	2.81	-	-	-

APPENDIX B4 ctd. : Density of mysids collected during the 24-hour sampling sessions.

d) Daylength data.

TIME	TIME OF SUNSET OR SUNRISE
11.10.1982	sunset 1829
12.10.1982	sunrise 0526
18.1.1983	sunset 2051
19.1.1983	sunrise 0556
12.4.1983	sunset 1743
13.4.1983	sunrise 0640

e) Tidal data.

DATE	TIME	HEIGHT (m)
11.10.1982	0828	1.02
	1422	1.48
	2158	0.39
12.10.1982	0505	1.20
	0928	0.99
	1524	1.45
18.1.1983	0950	1.37
	1735	0.53
19.1.1983	0050	1.19
	0503	1.08
	1039	1.31
12.4.1983	0643	1.29
	1254	0.75
	1935	1.30
13.4.1983	0124	0.83
	0745	1.28
	1335	0.80

APPENDIX C : FEMALE LENGTH AND BROOD SIZE.

APPENDIX C1: Tenagomysis sp.2 a) Female mean length carrying eggs throughout the year

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	-	-	-	SP $\bar{x}$=8.36	8.11	8.61
OCT	8.14	0.56	16	SD=0.97		
NOV	8.44	1.08	40	n=56		
DEC	7.98	0.71	27	SU $\bar{x}$=7.85	7.63	8.07
JAN	7.59	0.51	7	SD=0.68		
FEB	8.5	0.71	2	n=36		
MAR	7.8	0.40	19	AU $\bar{x}$=7.40	7.27	7.53
APR	7.0	0.95	3	SD=0.56		
MAY	7.27	0.51	52	n=74		
JUN	7.69	0.49	19	WI $\bar{x}$=7.54	7.46	7.62
JUL	7.52	0.37	53	SD=0.39		
AUG	7.47	0.33	20	n=92		
TOTAL	7.72	0.73	258		7.63	7.80

T.sp.2 b) Female mean length carrying eyeless larvae throughout the year

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	-	-	-	SP $\bar{x}$=8.76	8.61	8.91
OCT	8.45	0.29	24	SD=0.62		
NOV	8.93	0.69	43	n=67		
DEC	7.79	0.59	62	SU $\bar{x}$=7.94	7.84	8.04
JAN	8.07	0.73	83	SD=0.68		
FEB	7.91	0.68	34	n=179		
MAR	7.80	0.71	38	AU $\bar{x}$=7.66	7.53	7.79
APR	7.56	0.81	7	SD=0.64		
MAY	7.57	0.55	54	n=99		
JUN	7.69	0.49	30	WI $\bar{x}$=7.57	7.51	7.63
JUL	7.48	0.36	92	SD=0.41		
AUG	7.66	0.41	57	n=179		
TOTAL	7.87	0.69	524		7.81	7.93

APPENDIX C1: ctd. T.sp.2 c) Female mean length carrying eyed larvae throughout the year

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	-	-	-	SP $\bar{x}$=8.98	8.86	9.10
OCT	8.50	-	1	SD=0.39		
NOV	8.99	0.39	39	n=40		
DEC	8.34	0.62	70	SU $\bar{x}$=8.29	8.18	8.40
JAN	8.42	0.73	42	SD=0.65		
FEB	8.02	0.57	35	n=147		
MAR	7.79	0.51	12	AU $\bar{x}$=7.73	7.57	7.89
APR	7.83	0.29	3	SD=0.44		
MAY	7.65	0.41	13	n=28		
JUN	7.77	0.44	12	WI $\bar{x}$=7.71	7.61	7.81
JUL	7.67	0.39	31	SD=0.40		
AUG	7.74	0.42	18	n=61		
TOTAL	8.20	0.69	276		8.10	8.28

T.sp.2 d) Mean number of eggs per brood throughout the year

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	-	-	-	SP $\bar{x}$=14.86	13.64	16.1
OCT	14.44	5.28	16	SD=4.67		
NOV	15.03	4.46	40	n=56		
DEC	10.0	2.83	27	SU $\bar{x}$=9.83	8.92	10.74
JAN	9.57	3.10	7	SD=2.78		
FEB	7.50	0.71	2	n=36		
MAR	9.05	2.68	19	AU $\bar{x}$=7.70	7.12	8.27
APR	10.33	3.21	3	SD=2.51		
MAY	7.06	2.15	52	n=74		
JUN	8.53	2.04	19	WI $\bar{x}$=5.44	4.92	5.96
JUL	4.30	1.77	53	SD=2.53		
AUG	5.50	2.24	20	n=92		
TOTAL	8.74	4.73	258		8.16	9.32

APPENDIX C1: ctd. T.sp.2 e) Mean numbers of eyeless per brood throughout the year

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	-	-	-	SP $\bar{x}$=15.82	15.06	16.58
OCT	15.92	2.90	24	SD=3.16		
NOV	15.77	3.33	43	n=67		
DEC	8.81	2.60	62	SU $\bar{x}$=8.20	7.83	8.55
JAN	8.42	2.31	83	SD=2.43		
FEB	6.53	1.56	34	n=179		
MAR	8.71	2.40	38	AU $\bar{x}$=8.12	7.66	8.58
APR	9.29	2.75	7	SD=2.35		
MAY	7.56	2.14	54	n=99		
JUN	7.97	2.01	30	WI $\bar{x}$=5.12	4.80	5.44
JUL	4.36	1.62	92	SD=2.19		
AUG	4.84	1.89	57	n=179		
TOTAL	8.11	4.08	524		7.76	8.46

T.sp.2 f) Mean numbers of eyed per brood throughout the year

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	-	-	-	SP $\bar{x}$=15.9	14.85	16.95
OCT	14.0	-	1	SD=3.40		
NOV	15.95	3.43	39	n=40		
DEC	11.09	3.24	70	SU $\bar{x}$=9.48	8.9	10.0
JAN	9.81	2.65	42	SD=3.43		
FEB	5.89	1.43	35	n=147		
MAR	7.92	1.98	12	AU $\bar{x}$=7.79	7.08	8.5
APR	8.67	2.31	3	SD=1.93		
MAY	7.46	1.90	13	n=28		
JUN	7.75	1.91	12	WI $\bar{x}$=6.20	5.66	6.74
JUL	6.13	2.11	31	SD=2.14		
AUG	5.28	1.81	18	n=61		
TOTAL	9.52	4.24	276		9.02	10.02

APPENDIX C2: Anisomysis mixta australis a) Female mean length carrying eggs throughout the year

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	6.96	0.34	13	SP $\bar{x}$=7.13	6.92	7.34
OCT	7.18	0.25	8	SD=0.65		
NOV	7.25	0.94	15	n=36		
DEC	6.30	-	1	SU $\bar{x}$=5.64	5.50	5.78
JAN	5.64	0.60	5	SD=0.47		
FEB	5.62	0.46	38	n=44		
MAR	5.36	0.44	25	AU $\bar{x}$=5.49	5.35	5.63
APR	5.75	0.32	12	SD=0.44		
MAY	5.80	-	1	n=38		
JUN	-	-	-	WI $\bar{x}$= -	-	-
JUL	-	-	-	SD= -		
AUG	-	-	-	n= -		
TOTAL	6.05	0.89	118		5.89	6.21

A.mixta australis b) Female mean length carrying eyeless larvae throughout the year.

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	6.88	0.24	21	SP $\bar{x}$=7.07	6.97	7.18
OCT	7.29	0.30	33	SD=0.47		
NOV	6.91	0.66	22	n=76		
DEC	5.5	-	1	SU $\bar{x}$=5.80	5.68	5.92
JAN	6.09	0.66	13	SD=0.53		
FEB	5.75	0.49	63	n=77		
MAR	5.63	0.49	32	AU $\bar{x}$=5.63	5.50	5.76
APR	5.65	0.52	21	SD=0.49		
MAY	5.50	0.50	3	n=56		
JUN	-	-	-	WI $\bar{x}$= -	-	-
JUL	-	-	-	SD= -		
AUG	-	-	-	n= -		
TOTAL	6.22	0.82	209		6.11	6.33

APPENDIX C2: ctd. A.mixta australis c) Female mean length carrying eyed larvae throughout the year

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	7.00	0.35	5	SP $\bar{x}$=7.26	7.09	7.43
OCT	7.39	0.21	9	SD=0.35		
NOV	7.30	0.71	2	n=16		
DEC	-	-	-	SU $\bar{x}$=6.11	5.97	6.26
JAN	6.67	0.64	39	SD=0.74		
FEB	5.75	0.55	60	n=99		
MAR	5.68	0.25	6	AU $\bar{x}$=5.64	5.50	5.78
APR	5.59	0.41	17	SD=0.36		
MAY	5.83	0.06	3	n=26		
JUN	-	-	-	WI $\bar{x}$= -	-	-
JUL	-	-	-	SD= -		
AUG	-	-	-	n= = -		
TOTAL	6.16	0.78	141		6.03	6.29

A.mixta australis d) Mean number of eggs carried throughout the year.

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	5.85	1.07	13	SP $\bar{x}$=9.50	8.13	10.88
OCT	11.5	3.89	8	SD=4.21		
NOV	11.6	4.05	15	n=36		
DEC	9.00	-	1	SU $\bar{x}$=5.89	5.44	6.34
JAN	6.40	0.55	5	SD=1.51		
FEB	5.74	1.52	38	n=44		
MAR	6.52	1.19	25	AU $\bar{x}$=5.95	5.49	6.41
APR	5.08	0.99	12	SD=1.45		
MAY	2.00	-	1	n=38		
JUN	-	-	-	WI $\bar{x}$= -		
JUL	-	-	-	SD= -		
AUG	-	-	-	n= -		
TOTAL	7.01	3.09	118		6.45	7.57

APPENDIX C2: ctd. A.mixta australis e) Mean number of eyeless larvae carried throughout the year.

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	5.33	1.24	21	SP $\bar{x}$=7.86	7.12	8.60
OCT	9.27	3.20	33	SD=3.28		
NOV	8.14	3.43	22	n=76		
DEC	5.00	-	1	SU $\bar{x}$=5.29	4.97	5.61
JAN	5.85	1.91	13	SD=1.43		
FEB	5.16	1.31	63	n=77		
MAR	6.72	1.46	32	AU $\bar{x}$=5.96	5.51	6.41
APR	5.29	1.23	21	SD=1.71		
MAY	2.67	1.16	3	n=56		
JUN	-	-	-	WI $\bar{x}$= -		
JUL	-	-	-	SD= -		
AUG	-	-	-	n= -		
TOTAL	6.40	2.59	209		6.05	6.75

A.mixta australis f) Mean number of eyed larvae carried throughout the year.

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	5.00	1.41	5	SP $\bar{x}$=6.25	5.30	7.21
OCT	6.89	1.76	9	SD=1.95		
NOV	6.50	3.54	2	n=16		
DEC	-	-	-	SU $\bar{x}$=6.12	5.65	6.59
JAN	7.82	2.88	39	SD=2.4		
FEB	5.02	1.03	60	n=99		
MAR	6.67	1.21	6	AU $\bar{x}$=5.08	4.41	5.75
APR	5.06	1.25	17	SD=1.74		
MAY	2	-	3	n=26		
JUN	-	-	-	WI $\bar{x}$= -	-	-
JUL	-	-	-	SD= -		
AUG	-	-	-	n= -		
TOTAL	5.94	2.27	141		5.57	6.32

APPENDIX C3: Paramesopodopsis rufa a) Mean length of female carrying eggs throughout the year.

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	11.33	1.17	3	SP $\bar{x}$=10.25	10.05	10.45
OCT	11.0	0.57	2	SD=0.68		
NOV	10.13	0.56	41	n=46		
DEC	10.39	0.65	14	SU $\bar{x}$=10.15	9.89	10.42
JAN	9.90	0.79	15	SD=0.74		
FEB	10.50	-	1	n=30		
MAR	10.50	-	1	AU $\bar{x}$=10.5	-	-
APR	-	-	-	SD= -		
MAY	-	-	-	n=1		
JUN	-	-	-	WI $\bar{x}$=10.9	10.38	11.42
JUL	11.37	0.42	3	SD=0.65		
AUG	10.43	0.49	3	n=6		
TOTAL	10.26	0.72	83		10.11	10.41

P.rufa b) Mean length of female carrying eyeless larvae throughout the year.

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	11.81	0.68	18	SP $\bar{x}$=11.15	10.89	11.41
OCT	10.10	-	1	SD=0.88		
NOV	10.73	0.70	26	n=45		
DEC	10.47	0.77	34	SU $\bar{x}$=10.44	10.21	10.67
JAN	10.37	1.07	18	SD=0.87		
FEB	10.50	-	1	n=53		
MAR	10.03	0.69	4	AU $\bar{x}$=9.82	9.16	10.48
APR	9.00	-	1	SD=0.75		
MAY	-	-	-	n=5		
JUN	-	-	-	WI $\bar{x}$=10.35	9.66	11.04
JUL	10.7	-	1	SD=0.50		
AUG	10.0	-	1	n=2		
TOTAL	10.71	0.94	105		10.53	10.89

APPENDIX C3: ctd. P.rufa c) Mean length of female carrying eyed larvae throughout the year.

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	11.7	1.36	5	SP $\bar{x}$=11.7	11.07	12.33
OCT	-	-	-	SD=1.06		
NOV	11.7	0.89	6	n=11		
DEC	9.97	2.59	30	SU $\bar{x}$=10.77	10.53	11.01
JAN	11.11	1.19	12	SD=0.81		
FEB	10.5	-	1	n=43		
MAR	9.9	0.43	8	AU $\bar{x}$=9.90	9.60	10.20
APR	-	-	-	SD=0.43		
MAY	-	-	-	n=8		
JUN	-	-	-	WI $\bar{x}$= -	-	-
JUL	-	-	-	SD= -		
AUG	-	-	-	n= -		
TOTAL	10.82	0.96	62		10.58	11.06

P.rufa d) Mean number of eggs per brood throughout the year.

MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	10.67	4.04	3	SP $\bar{x}$=11.74	11.22	12.26
OCT	15.00	1.41	2	SD=1.81		
NOV	11.66	1.48	41	n=46		
DEC	10.93	1.73	14	SU $\bar{x}$=9.60	8.83	10.37
JAN	8.60	1.77	15	SD=2.16		
FEB	6.00	-	1	n=30		
MAR	7.00	-	1	AU $\bar{x}$=7.00	-	-
APR	-	-	-	SD= -		
MAY	-	-	-	n=1		
JUN	-	-	-	WI $\bar{x}$=6.50	5.66	7.34
JUL	6.67	0.58	3	SD=1.05		
AUG	6.33	1.53	3	n=6		
TOTAL	10.53	2.45	83		10.0	11.06

APPENDIX C3: ctd. P.rufa e) Mean numbers of eyeless larvae per brood throughout the year.

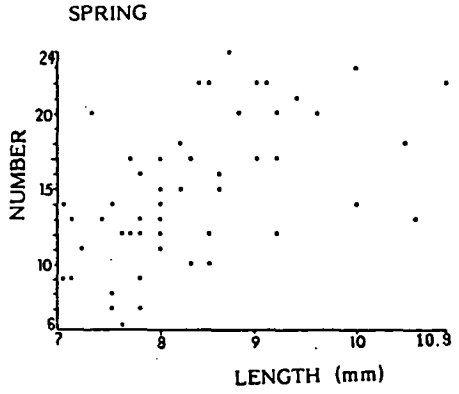
MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	10.0	2.35	18	SP $\bar{x}$=11.42	10.65	12.19
OCT	15.0	-	1	SD=2.64		
NOV	12.27	2.41	26	n=45		
DEC	10.15	2.29	34	SU $\bar{x}$=9.51	8.89	10.13
JAN	8.5	1.82	18	SD=2.29		
FEB	6.0	-	1	n=53		
MAR	5.0	0.82	4	AU $\bar{x}$=4.60	3.60	5.60
APR	3.0	-	1	SD=1.14		
MAY	-	-	-	n=5		
JUN	-	-	-	WI $\bar{x}$=6.0	2.08	9.90
JUL	8.0	-	1	SD=2.83		
AUG	4.0	-	1	n=2		
TOTAL	10.03	2.90	105		9.48	10.59

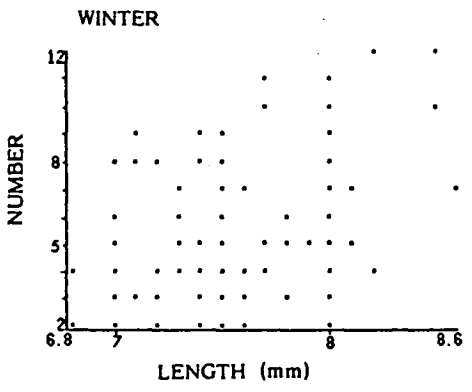
P.rufa f) Mean numbers of larvae per brood throughout the year.

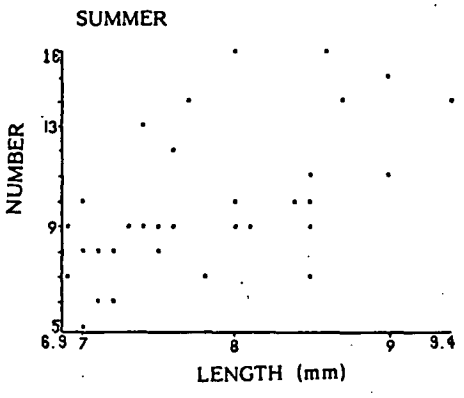
MONTH	$\bar{x}$	SD	n	SEASONAL	CL 95%	CU 95%
SEP	8.20	1.92	5	SP $\bar{x}$=11.0	9.00	13.00
OCT	-	-	-	SD=3.38		
NOV	13.3	2.34	6	n=11		
DEC	10.64	0.59	30	SU $\bar{x}$=10.12	9.26	10.98
JAN	10.83	3.43	12	SD=2.88		
FEB	6.0	-	1	n=43		
MAR	5.13	1.13	8	AU $\bar{x}$=5.13	4.35	5.91
APR	-	-	-	SD=1.13		
MAY	-	-	-	n=8		
JUN	-	-	-	WI $\bar{x}$= -	-	-
JUL	-	-	-	SD= -		
AUG	-	-	-	n= -		
TOTAL	9.63	3.30	62		8.81	10.45

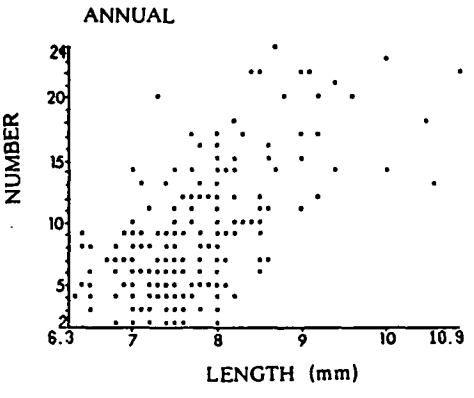
APPENDIX C4: Regression analysis between female length and number of eggs.

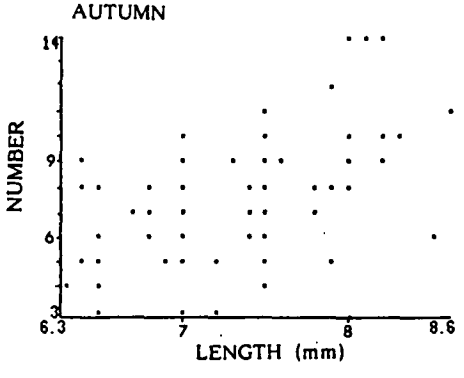
a) Tenagomysis sp.2



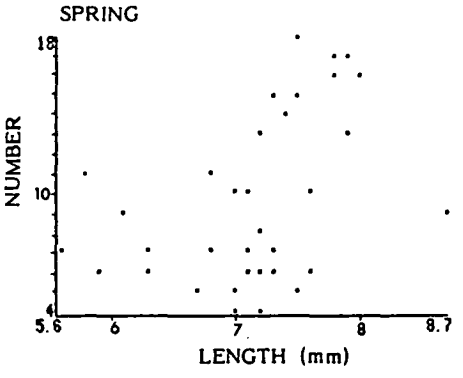


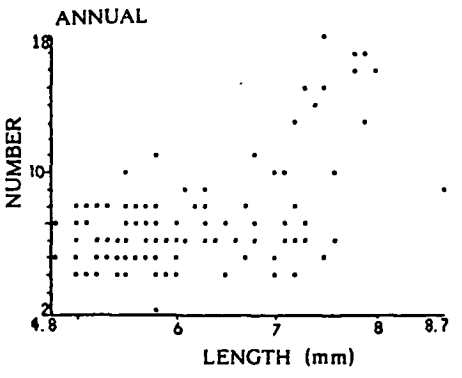


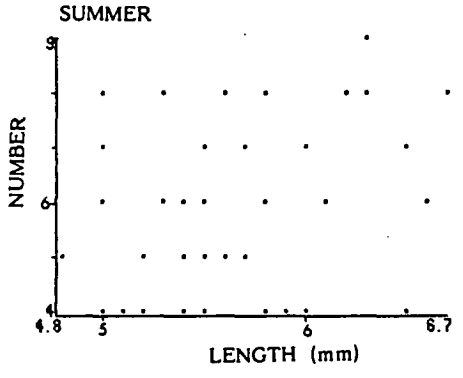


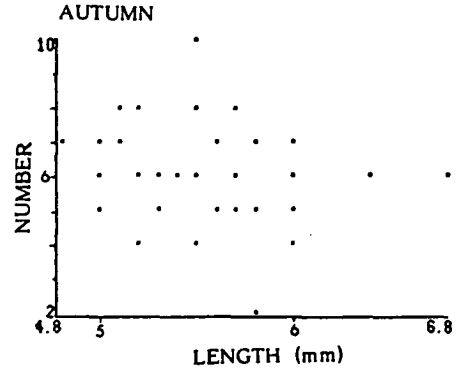


APPENDIX C4 ctd. b) Anisomysis mixta australis

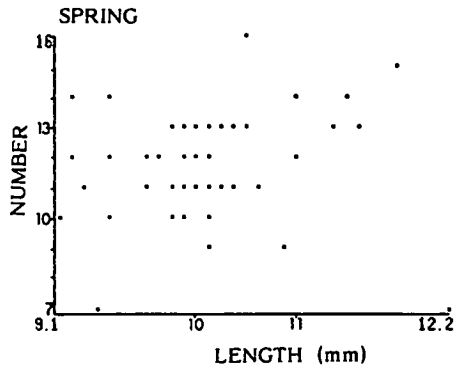


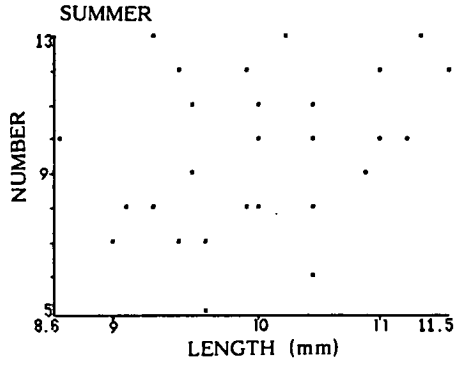


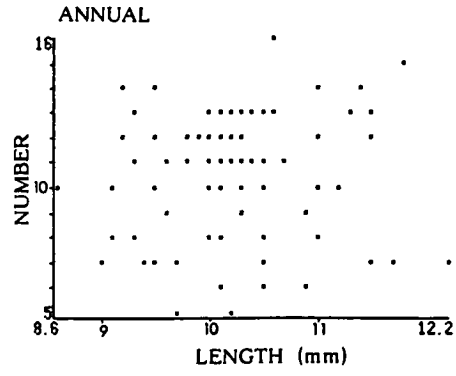




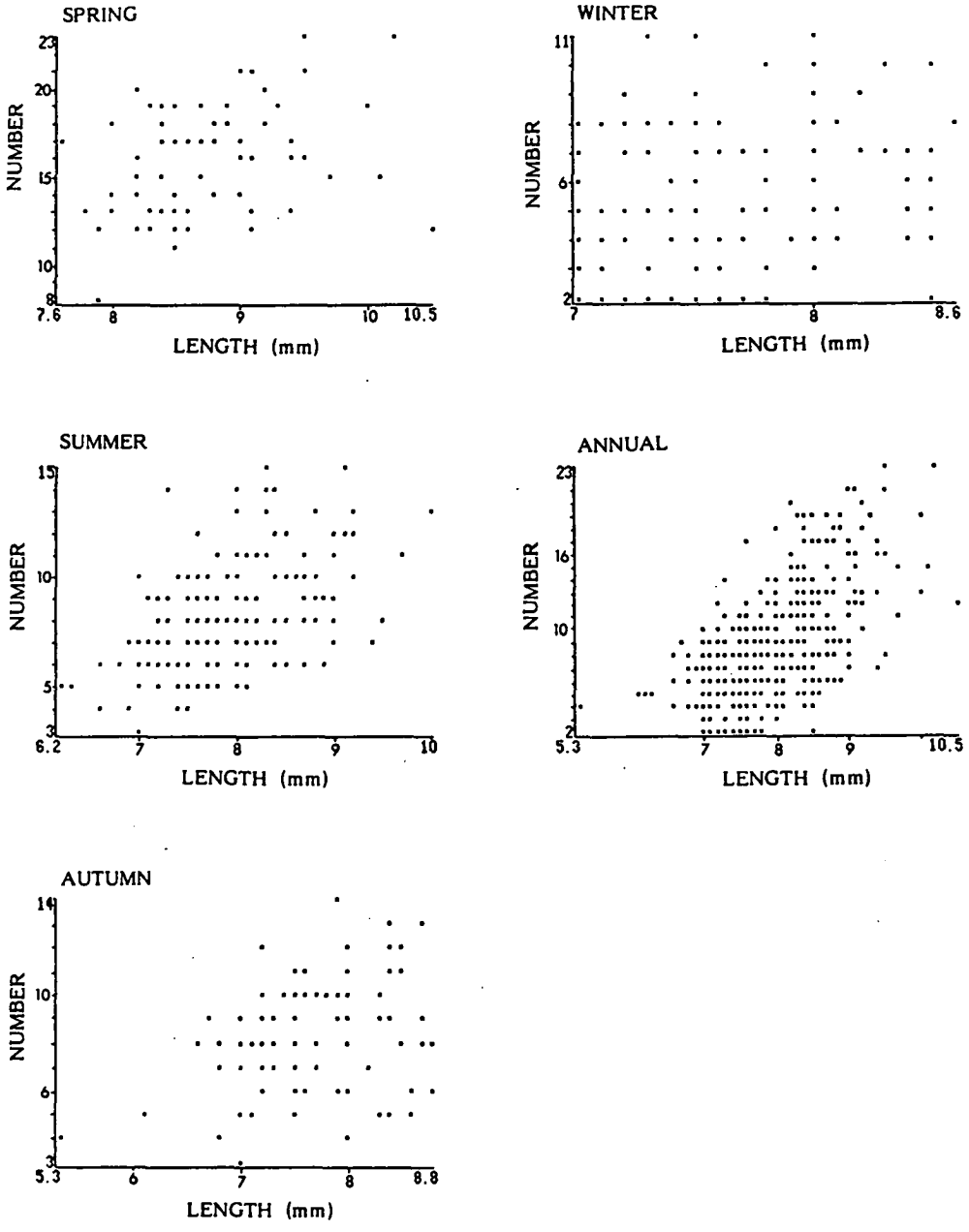
APPENDIX C4 ctd. c) Paramesopodopsis rufa



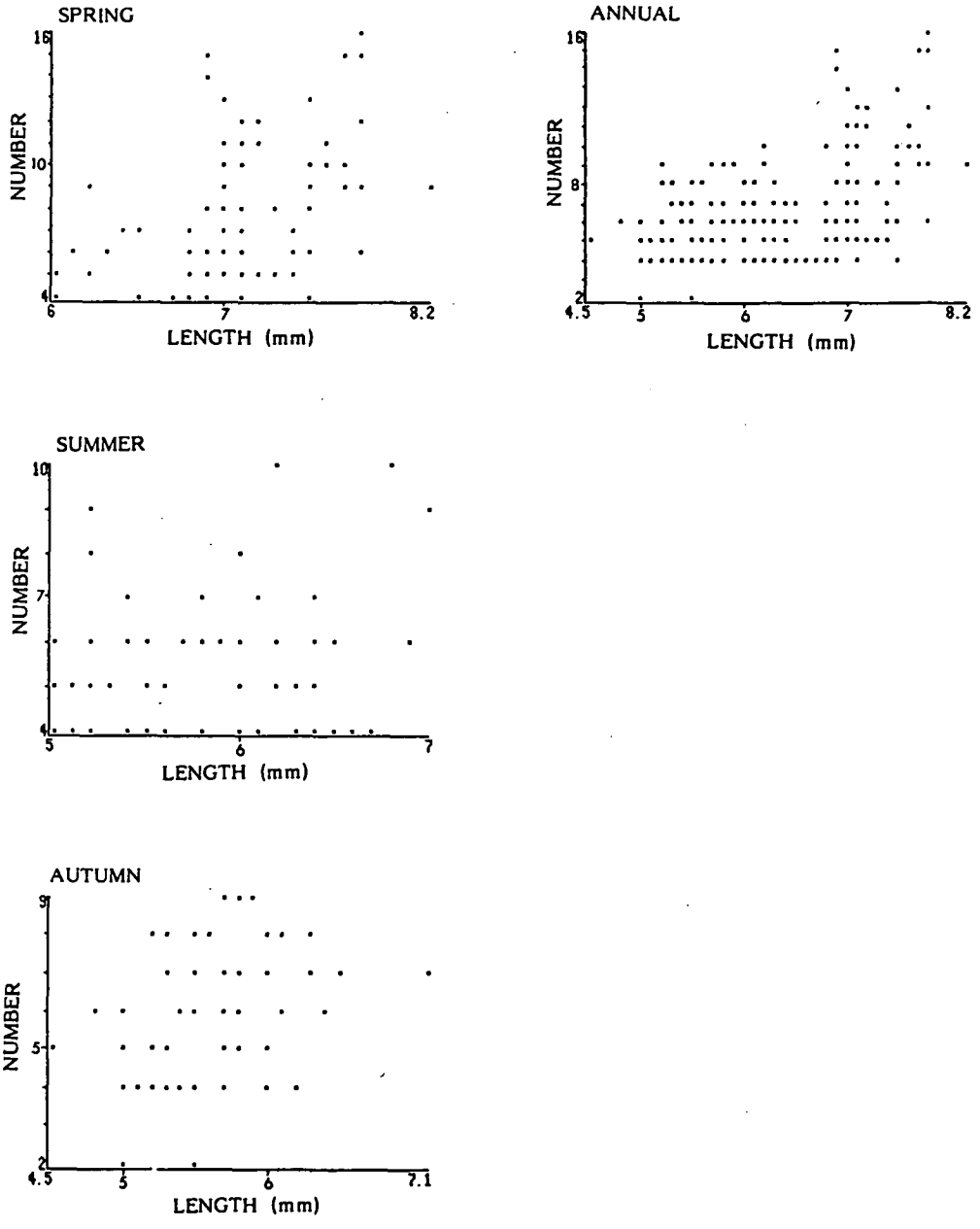




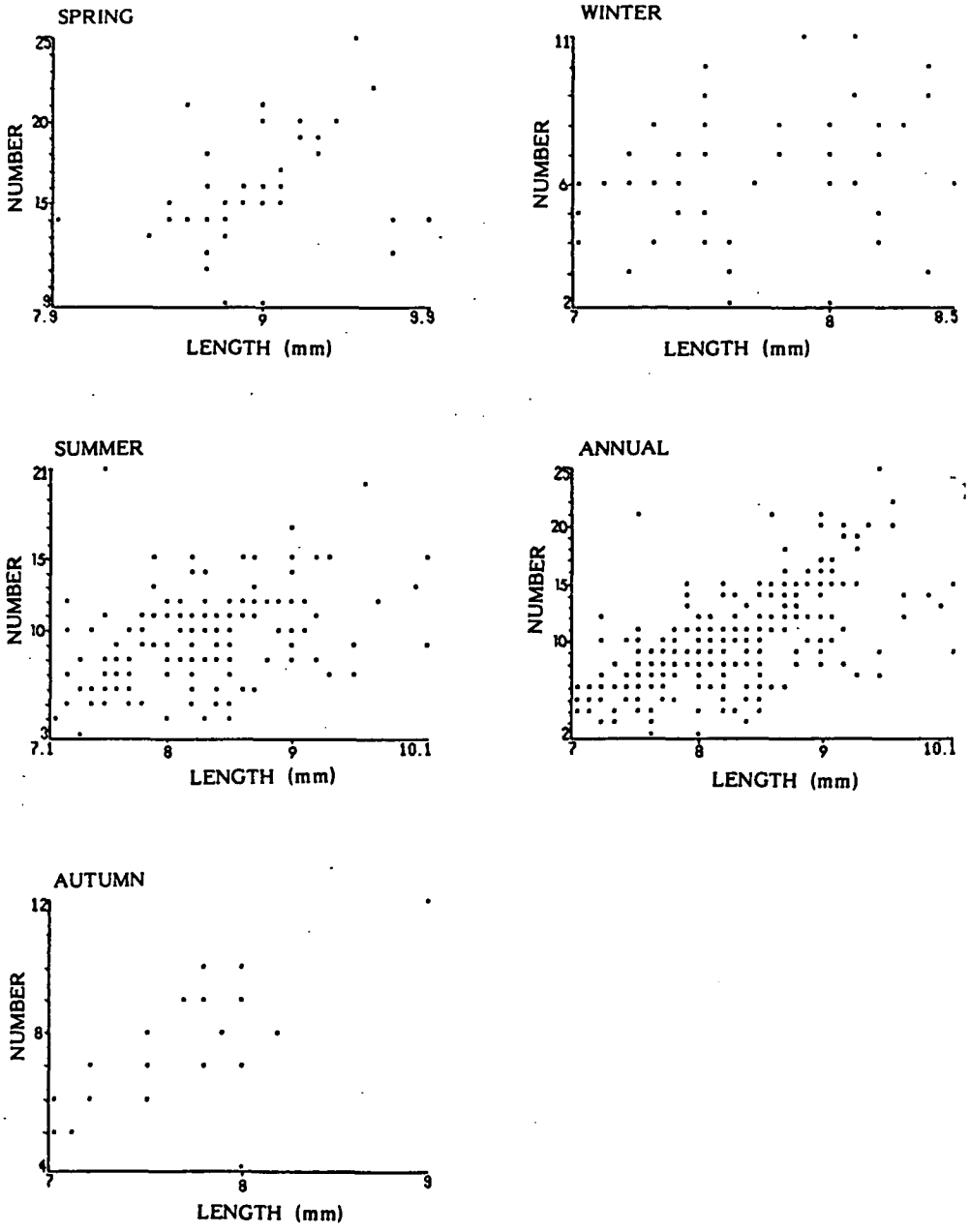
APPENDIX C5 : Regression analysis between female length and number of eyeless larvae. a) Tenagomysis sp.2



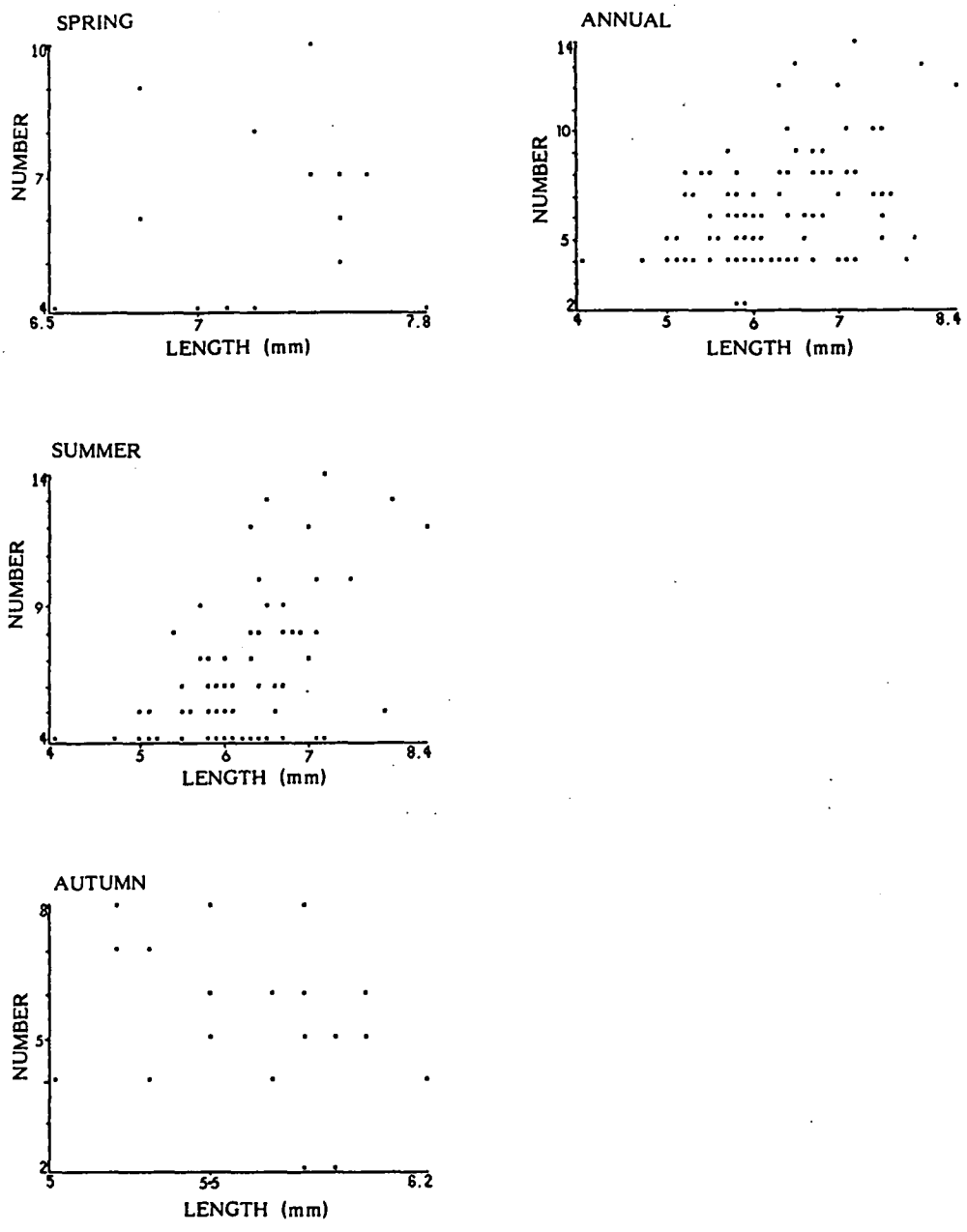
APPENDIX C5 ctd. b) Anisomysis mixta australis



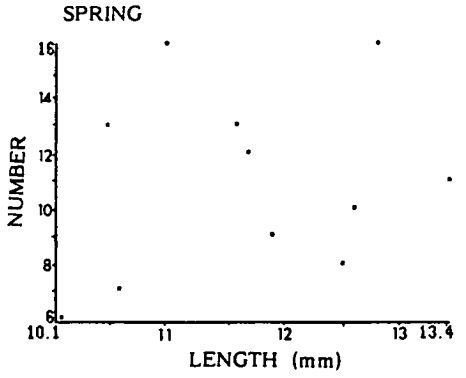
APPENDIX C6 : Regression analysis between female length and number of eyed larvae. a) Tenagomysis sp.2

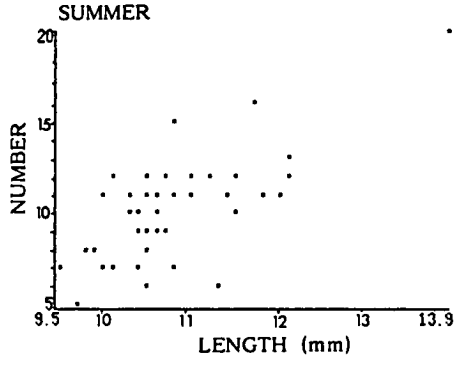


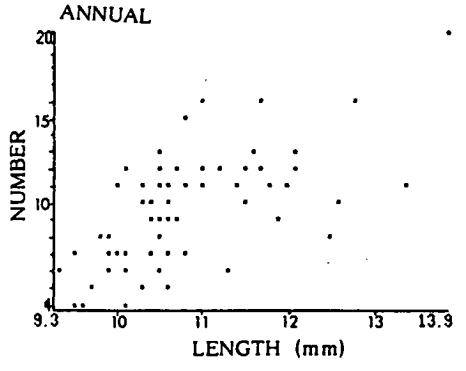
APPENDIX C6 ctd. b) Anisomysis mixta australis



APPENDIX C6 ctd. c) Paramesopodopsis rufa

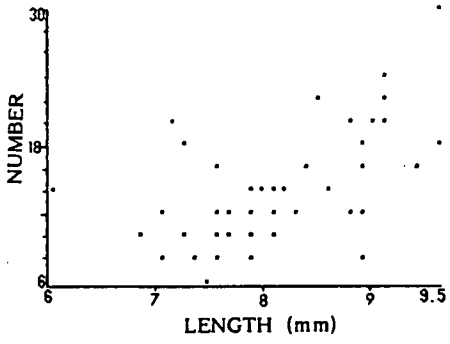




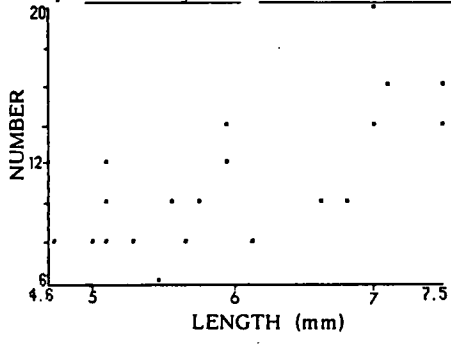


APPENDIX C7 : Regression analysis between female length and number of eggs developing in the ovaries.

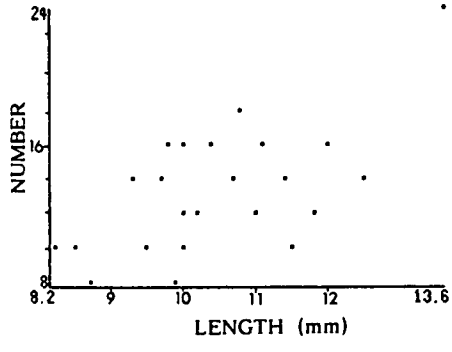
a) Tenagomysis sp.2



b) Anisomysis mixta australis



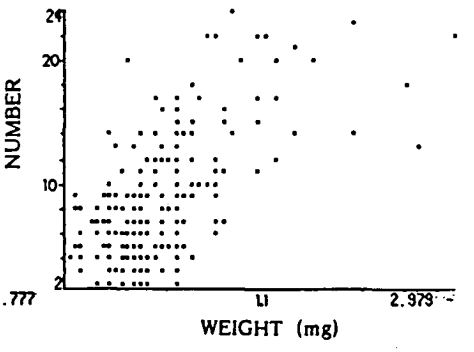
c) Paramesopodopsis rufa



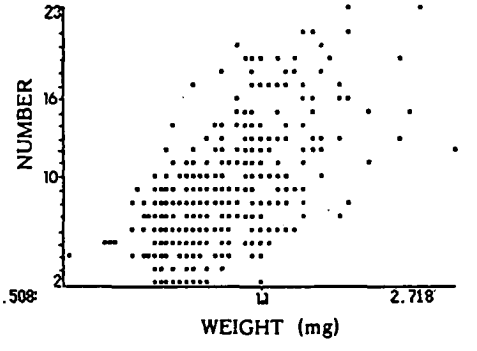
APPENDIX C8 : Regression analysis between female weight and number of young. a) Tenagomysis sp.2

ANNUAL DATA

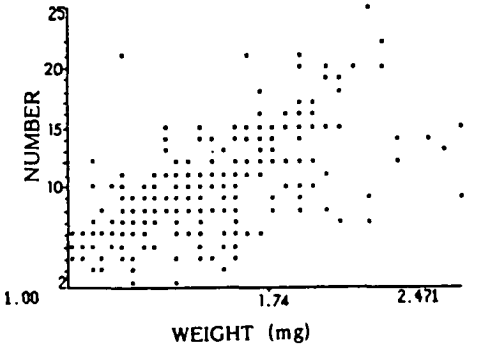
i) Eggs



ii) Eyeless larvae



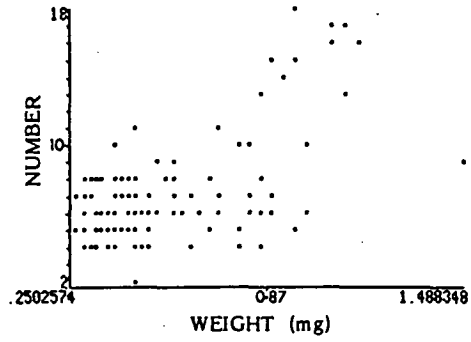
iii) Eyed larvae



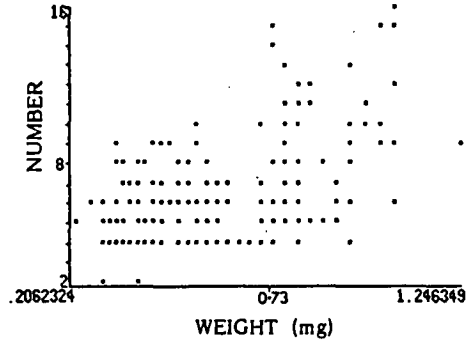
APPENDIX C8 ctd. b) Anisomysis mixta australis

ANNUAL DATA

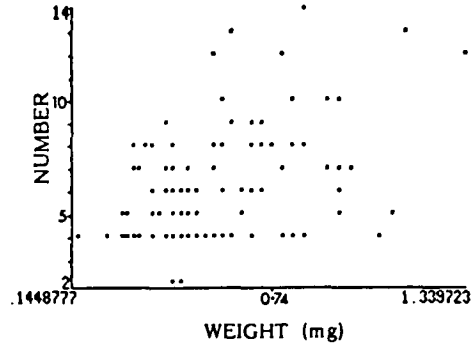
i) Eggs



ii) Eyeless larvae



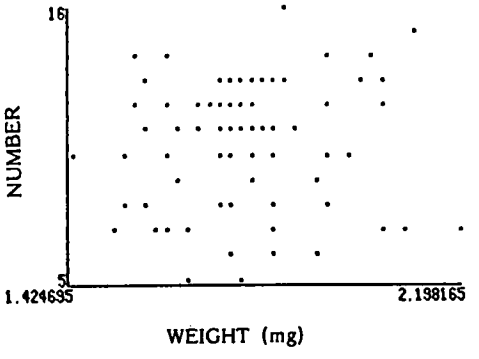
iii) Eyed larvae



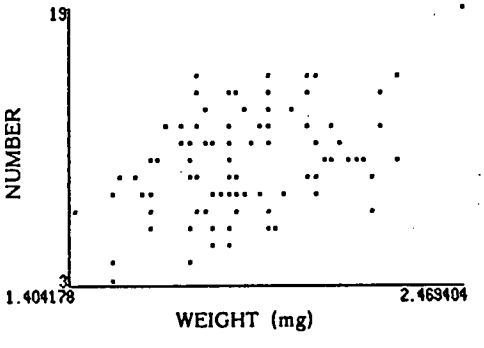
APPENDIX C8 ctd. c) Paramesopodopsis rufa

ANNUAL DATA

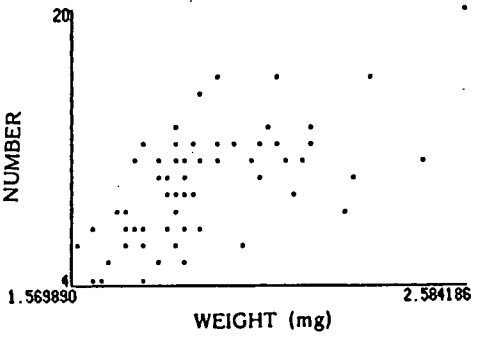
i) Eggs



ii) Eyeless larvae



iii) Eyed larvae



APPENDIX D: PRODUCTION CALCULATION

a) Tenagomysis sp.2

MONTH	SIZE CLASS (mm)											
	0-0.9	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	6-6.9	7-7.9	8-8.9	9-9.9	10-10.9	SUM
SEP	0	0	0	0	1	0	0	0	0	0	0	1
OCT	332	494	28	2	16	45	56	134	60	16	0	1183
NOV	1743	1656	1180	0	67	79	231	215	171	191	10	5543
DEC	6700	5506	7819	135	1015	775	790	1410	1700	510	30	26390
JAN	2871	7494	5935	5	50	165	235	1330	1705	370	25	20185
FEB	750	1241	1178	5	5	85	100	340	505	85	0	4294
MAR	1403	1437	570	3	153	115	153	529	212	9	0	4584
APR	83	167	69	103	378	246	59	71	43	0	0	1219
MAY	4031	4082	1119	110	500	510	770	1350	976	270	10	13728
JUN	921	996	411	10	26	224	247	517	608	47	0	4007
JUL	2150	2965	1471	30	390	545	1000	2405	1345	20	0	12321
AUG	418	847	370	10	56	122	105	437	334	20	0	2719
TOTAL	21402	26885	20150	413	2657	2911	3746	8738	7659	1538	75	
DENSITY	250.492	314.665	235.838	4.8338	31.0978	34.0707	43.8436	102.271	89.6419	18.0009	0.87781	

i) Size frequency method: Monthly production

Nj	6467.69	8124.66	6089.34	124.809	802.946	347.862	447.643	1044.18	915.243	183.79	8.96243		
N	-1657	2035.32	5964.53	-678.14	455.085	-99.782	-596.54	128.939	731.454	174.827	8.96243		
MID-L	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	
Wj	0.00156	0.02306	0.08067	0.18402	0.34072	0.5572	0.83915	1.1917	1.61959	2.12718	2.71858	3.397674399	
W	0.006	0.04313	0.12184	0.2504	0.43571	0.68379	1.00001	1.38927	1.85611	2.40477	3.03922		
P	-9.9426	87.7894	726.707	-169.8	198.287	-68.23	-596.54	179.131	1357.66	420.419	27.2388	Sum P -)	2152.7107
B	0.39106	7.25724	19.0244	0.88953	10.5956	18.9841	36.7912	121.876	145.183	38.2912	2.3864	Sum B -)	401.6694
											Annual P:B ---)		5.359

ii) Petrovich method: Daily production

INIT L	0.42	1	2	3	4	5	6	7	8	9	10	11	
INIT W	0.00102	0.00854	0.04668	0.12612	0.25528	0.44111	0.68965	1.00629	1.39595	1.86316	2.41216	3.04693	
Wt	0.00752	0.03815	0.07943	0.12916	0.18584	0.24854	0.31664	0.38965	0.46721	0.549	0.63478		
G	0.00054	0.00273	0.00569	0.00926	0.01332	0.00704	0.00897	0.01104	0.01324	0.01556	0.01799		
P	0.00488	0.03109	0.04853	0.00162	0.01497	0.00867	0.01422	0.04082	0.0429	0.01012	0.00057	Sum P -)	0.2184
B	0.01413	0.26231	0.68763	0.03215	0.38297	0.68617	1.3298	4.40516	5.24757	1.38402	0.08626	Sum B -)	14.5182
											Annual P:B---)		5.490

Formulae given on pages 301-302, where L = length, W = geometric mean of weight (Wj.Wj+1)1/2, P = production, B = biomass, N = mean annual density, Wt = Wi+1 - Wi and G = Wt/growth rate.

APPENDIX D: PRODUCTION CALCULATION (Cont.)

b) Anisomysis mixta australis

MONTH	SIZE CLASS (mm)									
	0-0.9	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	6-6.9	7-7.9	8-8.9	SUM
SEP	281	213	35	54	14	19	292	129	0	1037
OCT	115	371	76	0	0	1	28	471	2	1064
NOV	186	138	13	0	16	7	0	0	0	360
DEC	90	30	0	0	35	90	240	30	0	515
JAN	211	959	2831	1	39	301	515	136	10	5003
FEB	1567	2688	2731	10	301	1963	934	24	5	10223
MAR	632	780	220	97	611	416	86	0	0	2842
APR	1326	3402	2444	150	1335	2377	892	13	0	11939
MAY	42	160	160	10	2500	1360	80	0	0	4312
JUN	0	0	0	0	83	79	1	0	0	163
JUL	0	0	0	0	90	10	0	0	0	100
AUG	0	0	0	20	1290	370	30	0	0	1710
TOTAL	4450	8741	8510	342	6314	6993	3098	803	17	
DENSITY	52.0833	102.306	99.6021	4.00281	73.8998	81.8469	36.2594	9.39841	0.19897	

i) Size frequency method: Monthly production

Nj	1262.5	2479.89	2414.35	46.6327	860.933	953.517	422.422	109.491	2.318		
N	-1217.4	65.5365	2367.72	-814.3	-92.584	531.095	312.93	107.173	2.318		
MID-L	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	
Wj	0.00028	0.00766	0.0354	0.09708	0.20623	0.37639	0.62107	0.9538	1.38811	1.937497835	
W	0.00147	0.01646	0.05863	0.1415	0.27861	0.48349	0.76966	1.15065	1.63996		
P	-1.7954	1.0789	138.812	-115.22	-25.795	256.779	240.85	123.319	3.80142	Sum P -)	621.8280
B	0.0148	0.78315	3.52629	0.3886	15.2405	30.806	22.5196	8.96425	0.27619	Sum B -)	82.5194
									Annual	P:B ---)	7.536

ii) Petrovich method: Daily production

INIT L	0.39	1	2	3	4	5	6	7	8	9	
INIT W	0.00013	0.00227	0.01813	0.06116	0.14488	0.28284	0.48857	0.77559	1.15742	1.863155472	
Wt	0.00214	0.01586	0.04302	0.08372	0.13796	0.20573	0.28702	0.38183	0.70574		
G	0.00014	0.00107	0.0029	0.00271	0.00446	0.00665	0.00928	0.01234	0.02282		
P	0.00027	0.00395	0.01043	0.00039	0.01191	0.01968	0.01216	0.00419	0.00016	Sum P -)	0.0632
B	0.00053	0.02831	0.12746	0.01405	0.55086	1.11347	0.81396	0.32401	0.00998	Sum B -)	2.9826
										Annual P:B ---)	7.728

Formulae given on pages 301-302, where L = length, W = geometric mean of weight (Wj.Wj+1)1/2, P = production, B = biomass, N = mean annual density, Wt = Wi+1 - Wi and G = Wt/growth rate.

APPENDIX D: PRODUCTION CALCULATION (Cont.)

c) Paramesopodopsis rufa

MONTH	SIZE CLASS (mm)														
	0-0.9	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	6-6.9	7-7.9	8-8.9	9-9.9	10-10.9	11-11.9	12-12.9	13-13.9	SUM
SEP	53	190	41	2	1	0	0	1	0	3	11	17	21	6	346
OCT	30	15	0	8	61	56	16	5	5	1	2	4	2	0	205
NOV	700	282	173	47	887	737	503	220	189	176	44	10	6	0	3974
DEC	1038	1675	2022	30	100	105	115	30	105	245	370	130	15	0	5980
JAN	740	782	1397	54	247	178	132	133	108	188	202	92	35	5	4293
FEB	90	30	30	0	1	0	0	5	21	25	45	5	0	0	252
MAR	35	75	128	8	0	6	3	3	5	30	28	8	0	0	329
APR	0	30	0	1	8	23	16	24	10	10	10	0	0	0	132
MAY	0	0	30	0	60	220	361	470	680	140	60	0	0	0	2021
JUN	0	0	0	0	3	1	10	23	48	31	2	0	0	0	118
JUL	100	40	0	0	10	0	0	40	130	135	235	55	0	0	745
AUG	95	20	0	0	0	5	5	43	67	293	271	27	0	0	826
TOTAL	2881	3139	3821	150	1378	1331	1161	997	1368	1277	1280	348	79	11	
DENSITY	33.7196	36.7392	44.7214	1.75562	16.1283	15.5782	13.5885	11.669	16.0112	14.9462	14.9813	4.07303	0.92463	0.12875	

i) Size frequency method: Monthly production

Nj	816.688	889.824	1083.15	42.5211	390.627	349.107	304.518	261.502	358.812	334.943	335.73	91.2767	20.7209	2.88518	
N	-73.136	-193.33	1040.63	-348.11	41.5198	44.5892	43.0154	-97.309	23.8683	-0.7869	244.454	70.5558	17.8357	2.88518	
MID-L	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5
Wj	0.04182	0.16336	0.30781	0.46721	0.63807	0.81838	1.00677	1.20229	1.40418	1.61187	1.82489	2.04284	2.2654	2.49228	2.723238
W	0.08266	0.22424	0.37922	0.546	0.72262	0.9077	1.1002	1.29932	1.50444	1.71507	1.93079	2.15124	2.37613	2.6052	
P	-6.0453	-43.352	394.633	-190.06	30.0032	40.4737	47.3254	-126.44	35.9086	-1.3495	471.989	151.783	42.3799	7.51648	Sum B -> 854.764
B	1.41027	6.00172	13.7657	0.82024	10.291	12.7489	13.6805	14.0295	22.4826	24.0913	27.3391	8.32056	2.09465	0.32087	Sum P -> 157.397
														Annual	P:B ---> 5.431

ii) Petrovich method: Daily production

INIT L	0.57	1	2	3	4	5	6	7	8	9	10	11	12	13	14
INIT W	0.0492	0.0988	0.2334	0.38591	0.55136	0.72714	0.91163	1.10369	1.30247	1.50733	1.71774	1.93327	2.15356	2.37832	5.502749
Wt	0.0496	0.1346	0.15251	0.16545	0.17579	0.18449	0.19206	0.19878	0.20486	0.21041	0.21553	0.22029	0.22475	3.12443	
G	0.00334	0.00906	0.01027	0.01114	0.01184	0.01149	0.01197	0.01239	0.01276	0.01311	0.01343	0.01373	0.014	0.19467	
P	0.00407	0.01204	0.0166	0.00071	0.0069	0.00647	0.00588	0.00522	0.00739	0.00708	0.00727	0.00202	0.00047	0.00091	Sum P --) 0.0830
B	0.05097	0.21693	0.49756	0.02965	0.37197	0.4608	0.49448	0.50709	0.81263	0.87077	0.98816	0.30074	0.07571	0.0116	Sum B --) 5.6890
														Annual	P:B ---> 5.327

Formulae given on pages 301-302, where L = length, W = geometric mean of weight (Wj.Wj+1)1/2, P = production, B = biomass, N = mean annual density, Wt = Wi+1 - Wi and G = Wt/growth rate.

This article has been removed for copyright or proprietary reasons.

Fenton, G.E., Description of Paramesopodopsis rufa n.g. n.sp. from the coastal waters of Southern Tasmania. (Crustacea : Mysidacea), Hydrobiologia 122, 171-174 (1985).